A-4F Blue Angel Flight Usage Data, 1974-1975

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A-4F BLUE ANGEL FLIGHT USAGE DATA 1974 - 1975

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This report provides flight usage data collected and used to calculate/monitor structural fatigue life expended on individual Blue Angel aircraft and presents flight environmental data which were used to establish full scale fatigue test requirements. A total of 4386.0 hours of counting accelerometer data (recorded on a flight by flight basis) and 436.0 hours of oscillograph data (normal acceleration, airspeed, and altitude data) were processed and are presented. Load gate spectra developed from this data have application in fatigue life calculations/testing and in the identification of extreme or excessive trends detrimental to prolonging fatigue life.

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SUMMARY

The mission of the Blue Angel Flight Demonstration Squadron is to demonstrate precision techniques of naval aviation. The flight demonstration consists of six aircraft, four "diamond" and two "solo," which perform a prescribed sequence of precise aerobatic and close formation maneuvers at low altitudes. The maneuvers performed represent tactical techniques developed in practice and actual combat. During such maneuvers, pilots and aircraft are repeatedly subjected to high magnitude positive and negative loads or g's. This type of flight loading significantly affects aircraft fatigue life expectancy, and since Blue Angel aircraft were recruited from the fleet where additional fatigue damage was previously accumulated, the need to assess and monitor each aircraft is strongly accentuated.

The objective of the Blue Angel Structural Fatigue Life Monitoring Program, AIRTASK A4101A1/001-2/6A0400000[illegible] sponsored by the Naval Air Systems Command (AIR-530), is to maximize operational availability of squadron aircraft without compromising structural reliability. By combining flight usage data with cumulative fatigue damage theory and test results, the structural fatigue life expended for each aircraft is reported throughout its service life. Based on data generated by this program, aircraft may be rotated through the solo and diamond positions to efficiently prolong operational life. Usage data is continuously monitored for adverse trends having a projected impact on aircraft availability.

Reported herein are data representing 4386.0 hours of counting accelerometer reports and 436.0 hours of VGH oscillograph records which were collected during 1974-1975. Load spectra presented have application in fatigue life calculations, in the identification of extreme or excessive exceedance trends detrimental to prolonging fatigue life, and in the development of a loading spectrum for the full scale fatigue test (to establish Blue Angel aircraft fatigue life limits). Additionally, normal acceleration, airspeed and altitude flight parameters obtained from oscillograph units were used to determine the flight test condition "point in the sky." The "point in the sky" identifies the aircraft gross weight, airspeed, and altitude at which all maneuvers are expected to be performed. These parameters have considerable impact on aircraft wing loading, center of pressure, tail loads, etc., and must be carefully considered in a fatigue test program in order to simulate actual loads as accurately as possible.

This report provides the basic data upon which the NAVAIRDEVCEN fatigue life monitoring program (i.e., tail-tracking) is based. No attempt is made herein to evaluate the data for planning projected operational service life of squadron aircraft. A follow-on report addressing the structural fatigue integrity of individual airplanes is planned for issue in FY 77.

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INSTRUMENTATION

Blue Angel aircraft were equipped with counting accelerometer and oscillograph recorders during the 1974-75 seasons for the purpose of obtaining normal acceleration, airspeed, and altitude data. Descriptions of these recording devices are contained in Appendix A. Accelerometer groups "counting" normal accelerations at the 5, 6, 7, and 8g levels were installed in all A-4F aircraft (see Figure 1). Oscillograph systems were installed in the diamond "slot" (number four position) and both solo (number five and six positions) aircraft. These three positions were chosen on the basis of the extreme flight loading severity experienced by the two solo positions, and the relative flight load severity of the diamond slot aircraft among diamond positions. Table I contains a list of pilots and the position history of instrumented aircraft during the 1974-75 seasons.

DATA PROCESSING

Counting accelerometer data for each aircraft were submitted monthly by the Blue Angel Squadron using the forms of Figure 2. These reports reflected daily flight by flight information including flight date, flight duration, counting accelerometer readings, and aircraft flight purpose or utilization. Upon receipt at NAVAIRDEVCEN, counting accelerometer data were quality checked for erroneous readings (or component malfunction) and classified into utilization categories. For the purpose of this report, eight utilization categories are identified: solo show, solo practice, diamond show diamond practice, cross country, check-out, other, and unknown. The latter two utilizations were created to account for flights where little or no information was available (i.e., "unknown" refers to unknown flight time in one of the above categories, while "other" refers to flight time which does not fit any of the above).

Oscillograph VGH data, recorded on light sensitive film (called records), were collected by squadron personnel and forwarded weekly to NAVAIRDEVCEN. These records contain a continuous time history of normal acceleration, airspeed, and altitude flight parameters during wheels up flight. Upon receipt, records were logged and flight parameter traces reviewed for clarity and continuity (see Figure 3). Acceptable records were then analyzed to determine scale factors, number of flights on the record, flight duration, and gross weight change during each flight (using fuel consumption and flight maneuver data). Scale factors, (referred to as sensitivities and defined in units of deflection distance per parameter unit, e.g., 6.35 millimetres per "g") were determined initially from oscillograph galvanometer calibrations prior to aircraft installation and were also recorded at the beginning of each record. Serving as a calibration measure of the oscillograph internal circuitry for a particular record, sensitivities were monitored for deviation throughout the "reading" process. Where deviations occurred, adjustments were made to the data based on either previous and subsequent record sensitivities or known information about the parameters (i.e., adjusting the sensitivity to yield approximately the same number of normal acceleration exceedances indicated by known counting accelerometer data).

"Reading" of records was accomplished using electronic, semi-automatic equipment on a flight by flight basis. Only peak values of normal acceleration (n_z) above + 2.0g and below + 0.2g were read along with simultaneous values of gross weight, airspeed, and altitude. More than one n_z peak per maneuver was read if the trace returned to a position at least one-half the distance of the previous peak (e.g., if a positive maneuver of 5.0g was read followed by a positive 3.0g reading, then somewhere between, the aircraft must have experienced + 2.5g or less). Values of normal acceleration, gross weight, airspeed (knots) and altitude (feet) in order of occurrence were classified by aircraft and placed on computer tapes referred to as listings.

Together with each oscillograph record, the Blue Angel Squadron forwarded pilot flight reports (Figure 4) to aid in the clarification and verification of oscillograph data. Containing counting accelerometer readings and other pertinent flight information, these reports were completed after each flight and corresponded to flights on the oscillograph record. Upon receipt at NAVAIRDEVCEN, pilot flight report data were matched to both oscillograph flight data and flight data from the counting accelerometer reports (Figure 2) as a check to insure accuracy. It is noted that flight duration values as indicated on the pilot flight reports and counting accelerometer reports reflect time between takeoff and landing. Actual oscillograph flight duration values, on the other hand, reflect the time that the oscillograph is operational (i.e., landing gear retracted; wheels-up) and therefore do not include taxi time or the time for those solo and diamond maneuvers which are performed with landing gear extended.

DISCUSSION

Counting Accelerometer

"Counting" positive normal accelerations or maneuver load exceedances between + 5.0g and + 8.0g, accelerometer groups provided 1782.1 and 2603.9 hours of acceptable data in 1974 and 1975, respectively, (Tables II and III). For each aircraft and year, data obtained from the monthly records (Figure 2) were classified into the eight utilizations previously mentioned and are presented in Appendix B. These cumulative exceedance data provided the basis for the + 5.0g to + 8.0g contribution to fatigue life expenditure in accordance with the fatigue analysis of reference (a). Further, these data and corresponding flight hours formed the basis for the development of an 5.0g to 8.0g exceedance rate per 1000 hours for each utilization. Tables IV and V summarize the "g" load history for each squadron aircraft. Cumulative exceedance rates/1000 hours for each utilization category are also shown. The "other" and "unknown" utilization rates are not computed, since they are not normally scheduled missions, but serve as categories for data about which little or no information is available. Graphically, the utilization cumulative exceedance rates are plotted in Figures 5 through 10. Figures 11 thru 15 compare 1974 versus 1975 rates for solo show, solo practice, diamond show, diamond practice, and cross country flights. Table VI contains cumulative exceedance rates per 1000 flight hours of the combined 1974-75 period. It is noted for graphical purposes, all exceedance ranges are plotted at the range mid point (e.g., range 5-5.99 plotted at 5.5). Additionally, where plotted points did not fall on a smooth curve, the curve was faired. Exact points may be obtained from the appropriate table.

OSCILLOGRAPH

To obtain maneuver load spectra in both the positive and negative load regimes, 157.1 and 278.9 hours of acceptable oscillograph data were collected during the 1974 and 1975 seasons, (refer to Table VII). Table VIII presents actual cumulative exceedance data for each oscillograph instrumented aircraft (e.g., aircraft no. 154986 flew 63.02 flight hours and experienced no negative g's below - 3.0, eight occurrences below - 2.00, thirty one occurrences below - 1.00, etc.). To develop cumulative g count data for each specific utilization, the following criteria were applied to the data:

1. Only oscillograph flights with matching pilot flight reports (Figure 4) were selected. Additionally, pilot flight reports also must have agreed with corresponding counting accelerometer reports (Figure 2).

2. Only solo show, solo practice, diamond show, diamond practice, and cross country flights were selected. The relative importance of these utilizations and the lack of oscillograph data in the check out utilization were responsible for this criterion.

Table IX presents a list of instrumented aircraft and the amount of available oscillograph data after the above criteria were applied. Data are presented by year, aircraft, and mission utilization (solo show, solo practice, diamond show, diamond practice) in Table X. All data were grouped by mission category and are presented in Table XI. Exceedance rates/1000 hours are given in Table XII. Cross-country flight data, as indicated in Table XIII, reflect data from all instrumented aircraft of Table IX. Comparisons of 1974 versus 1975 oscillograph data for each category are shown in Figures 16 through 20. Figures 21 through 25 graphically present combined 1974-75 oscillograph and counting accelerometer cumulative utilization exceedance rates taken from Tables VI, XII, XIII (check out utilization excluded).

Based on data contained in this report, the following are noted:

1. Solo and diamond practice spectra are lower than their respective show rates.

2. Solo show exceedance rates at all g levels are the most severe. The maximum positive and minimum negative g's recorded (+ 9.19 and - 4.39 in 1975) occurred during solo show flights.

3. Solo and diamond practice utilization rates obtained from oscillograph data do not reflect the extensive practice sessions between January and March since oscillograph units were not operational during this period. (See dates of installation in Table VII). Consequently, small differences result between oscillograph and counting accelerometer exceedance rates.

4. The time lapse between aircraft acceptance in November 1973 and counting accelerometer installation in March 1974 accounts for the large amounts of "unknown" usage recorded.

5. Diamond show and diamond practice counting accelerometer data reflect all diamond position aircraft, as opposed to oscillograph data which reflect diamond slot usage only.

6. Solo show and solo practice exceedance rates indicate a significant increase in frequency of negative g occurrence in 1975 from 1974. Diamond show and diamond practice exceedance rates indicate a significant decrease in negative g occurrence in 1975 from 1974.

7. At "g" levels common to both the oscillograph and counting accelerometer (+ 5.0g to + 8.0g):

a. 1974 solo show and solo practice rates are generally in good agreement with 1975 data.

b. The slot diamond airplane in 1975 flew less severely in shows than in 1974 (Figure 18 and Table XII). This decrease is not notable in Figure 13 which indicates the "g" count rate of diamond show aircraft flight as an aggregate did not significantly change from 1974 to 1975.

c. Diamond practice rates (from Figures 14 and 19, Tables IV, V, and XII), reflect a significant increase in 1975 from 1974.

8. Cross-country exceedance rates (from Figure 15) generated from counting accelerometer data indicate little or no change from 1974 to 1975. Oscillograph rates (Figure 20) indicate an increase in frequency at the negative g levels in 1975 from 1974. Differences between counting accelerometer and oscillograph rates (especially at the + 5.0g to + 7.0g levels in Figure 25) are due to the fact that oscillograph rates are influenced almost entirely by solo aircraft.

9. The utilization exceedance spectra of Figures 21-25 and Tables VI, XII, and XIII represent the complete positive and negative (oscillograph and counting accelerometer) maneuver load exceedance rates for solo show, solo practice, diamond show, diamond practice, and cross-country for combined 1974-75. These rates were based on the greatest amount of available data and together with the counting accelerometer data of Appendix B provide the spectra/data required to project/calculate individual aircraft fatigue life. These spectra also serve as a comparison measure to identify excessive or extreme exceedance trends detrimental to fatigue life.

In an effort to verify counting accelerometer calibration levels and provide a check on total "g" count exceedances as measured by both the accelerometer and oscillograph, the data of Table IX was compared with corresponding counter reports. For each aircraft, oscillograph exceedance data was classified into counting accelerometer calibration ranges obtained from Table A-I, Appendix A (e.g., counter calibration ranges for aircraft 154177 were 5.09-6.07, 6.08-7.11, 7.12-8.10, 8.11 and up). Dates of transducer (range) changes were applied to the oscillograph data appropriately. Using only solo show, solo practice, diamond show, and diamond practice utilizations (from the data of Table X), the results of this comparison are indicated in Table XIV. Exact verification of counting accelerometer and oscillograph exceedances was not obtained; however, the oscillograph values were reasonably approximate at all g levels (or calibration ranges) to be considered a good indicator of exceedance trend. Discrepancies may be due to a combination of inconsistencies in oscillograph calibration techniques, and small inherent human and machine error common to oscillograph "reading" processes.

In addition to recording maneuver load (normal acceleration) histories, oscillograph units provided a continuous time history of aircraft airspeed and altitude. These parameters can affect the critical flight condition determination for full scale fatigue tests and analyses by influencing such factors as wing center of pressure, wing load distributions, tail loads, etc. The fatigue test critical flight condition "point in the sky" determines the airspeed and altitude at which all maneuvers are expected to occur. To provide a survey of airspeed, altitude, and normal acceleration parameters to be used in full scale fatigue test loads considerations, the oscillograph data indicated by Table VII (pilot report sheet match not required) were classified by solo or diamond aircraft position for the combined 1974-75 seasons. Altitude and airspeed versus "g" exceedance data are presented in Appendix C, indicating "where" recorded maneuvers occur. Altitude bands chosen range from below sea level, -609.6 metres (-2000 ft.), to 9143.7 metres (30,000 ft.) for airspeed values ranging from 100 to 699 knots in increments of 50 knots. Also indicated is the average aircraft gross weight during maneuver exceedance for the altitude band indicated. Table XV summarizes this data in terms of percent of exceedances occurring below various airspeed values in altitude bands for diamond and solo aircraft. This table indicates:

a. For diamond utilization, 92.6% of all exceedances occurred below 1523.7 metres (5,000 feet) with 99.3% of these occurring at less than 500 knots.

b. For solo utilization, 87.2% of all exceedances occurred below 1523.7 metres (5,000 feet) with 99% of these occurring below 500 knots.

Figure 1. Blue Angels

"BLUE ANGELS" COUNTING ACCELEROMETER REPORT

A/C SER NUMBER _____ MONTH/YR _____

START HOURS _____ START RDGS

DAY	FLT HRS DAILY	FLT HRS TOTAL	FLIGHT PURPOSE PRACTICE	SHOW	CROSS CT	CHK OUT	POSITION DIAM	SOLO	COUNTER READINGS AT 2400 HRS 1	2	3	4	REMARKS

Figure 2. Blue Angels Counting Accelerometer Report

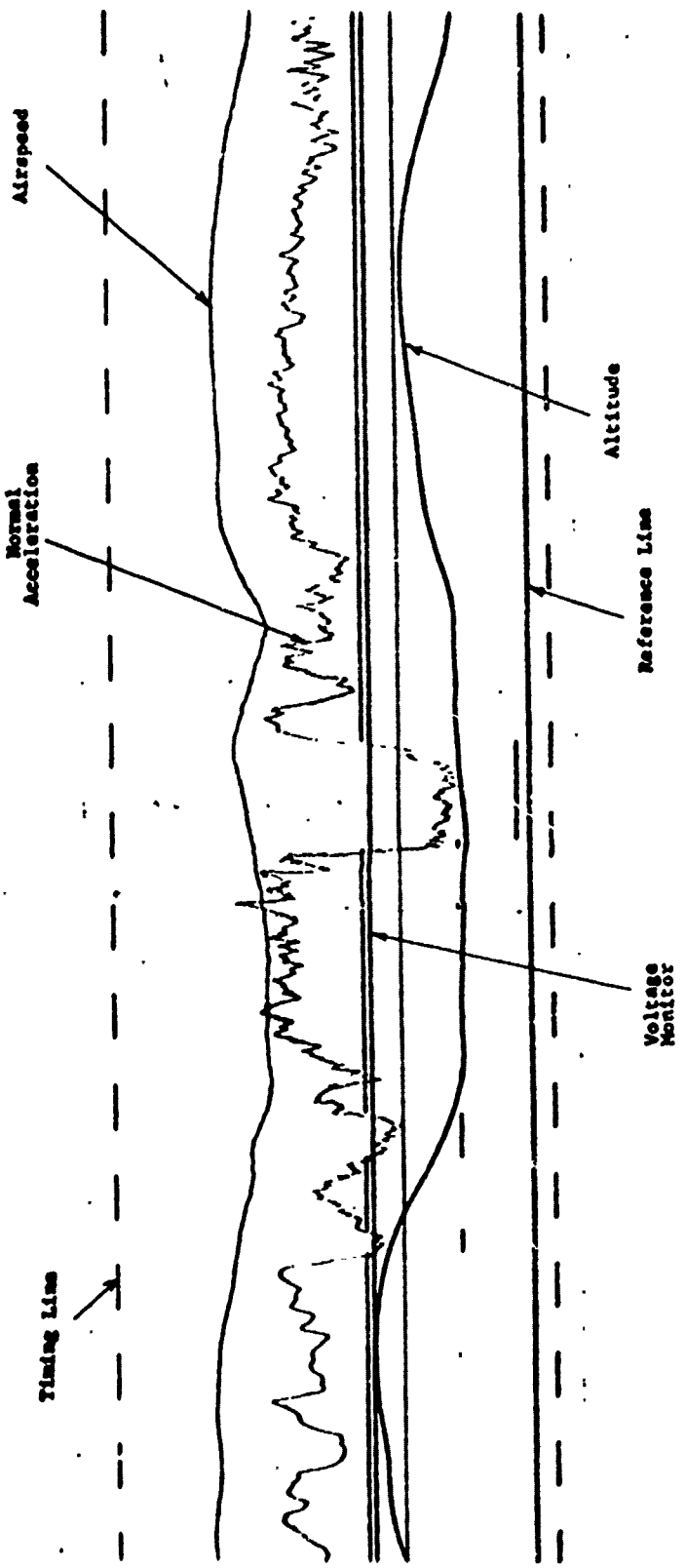

Figure 3. Oscillograph Trace

PILOT FLIGHT REPORT

NASC AIR TASK 10400301/NJ201 "Blue Angels" A-4F Aircraft Structure Integrity

TO THE PILOT: This aircraft is equipped with flight recorders which automatically produce a record of airspeed, altitude, and flight accelerations. This information will contribute to improvement of structural design requirements and fatigue life determination. The following information is required for proper evaluation of the recorded data. Your assistance is greatly appreciated.

DATE _____ "BLUE ANGELS"

TAKE OFF TIME _____ MODEL A-4F

FLIGHT DURATION _____ A/C SER NO. _____

LOCATION _____

GROSS WEIGHT: (TAKE OFF) _____ (LANDING) _____

FUEL WEIGHT: (TAKE OFF) _____ (LANDING) _____

HIGH "G" LOAD _____

REMARKS (TYPE OF SHOW, UNUSUAL MANEUVERS, WEATHER, ETC.) _____

_____

_____

_____

COUNTING ACCELEROMETER READINGS

	1	2	3	4
TAKE OFF				
LANDING				

OSCILLOGRAPH MAG. SER. NO. _____

THANK YOU

NAVAL AIR DEVELOPMENT CENTER

WARMINSTER, PA 18974

PLEASE RETURN THIS REPORT WITH OSCILLOGRAPH MAGAZINE TO NAVAIRDEVCEN (CODE 3021)

Figure 4. Pilot Flight Report

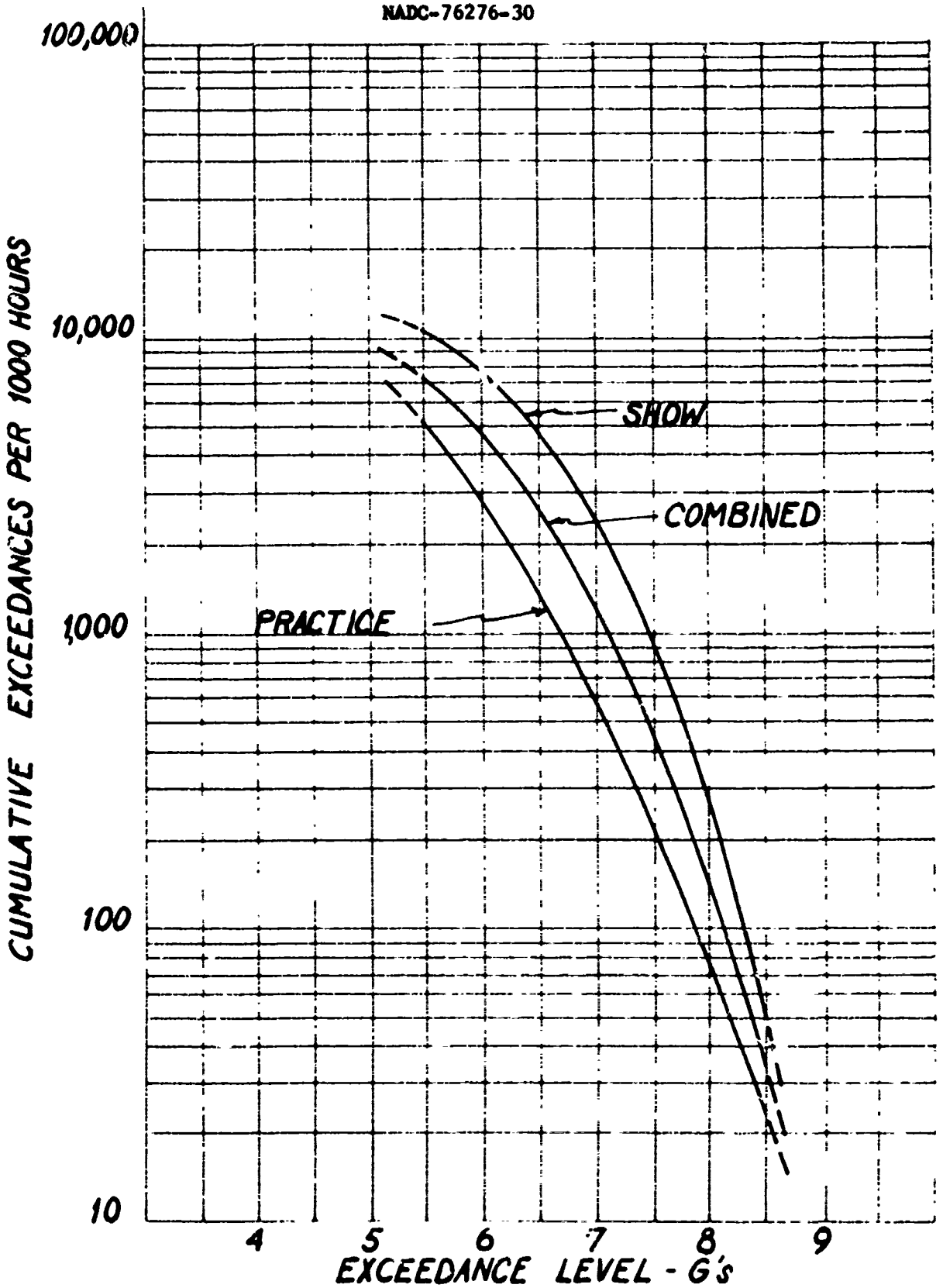

Figure 5. Blue Angel 1974 Counting Accelerometer Rates per 1000 Hours - Solo Aircraft

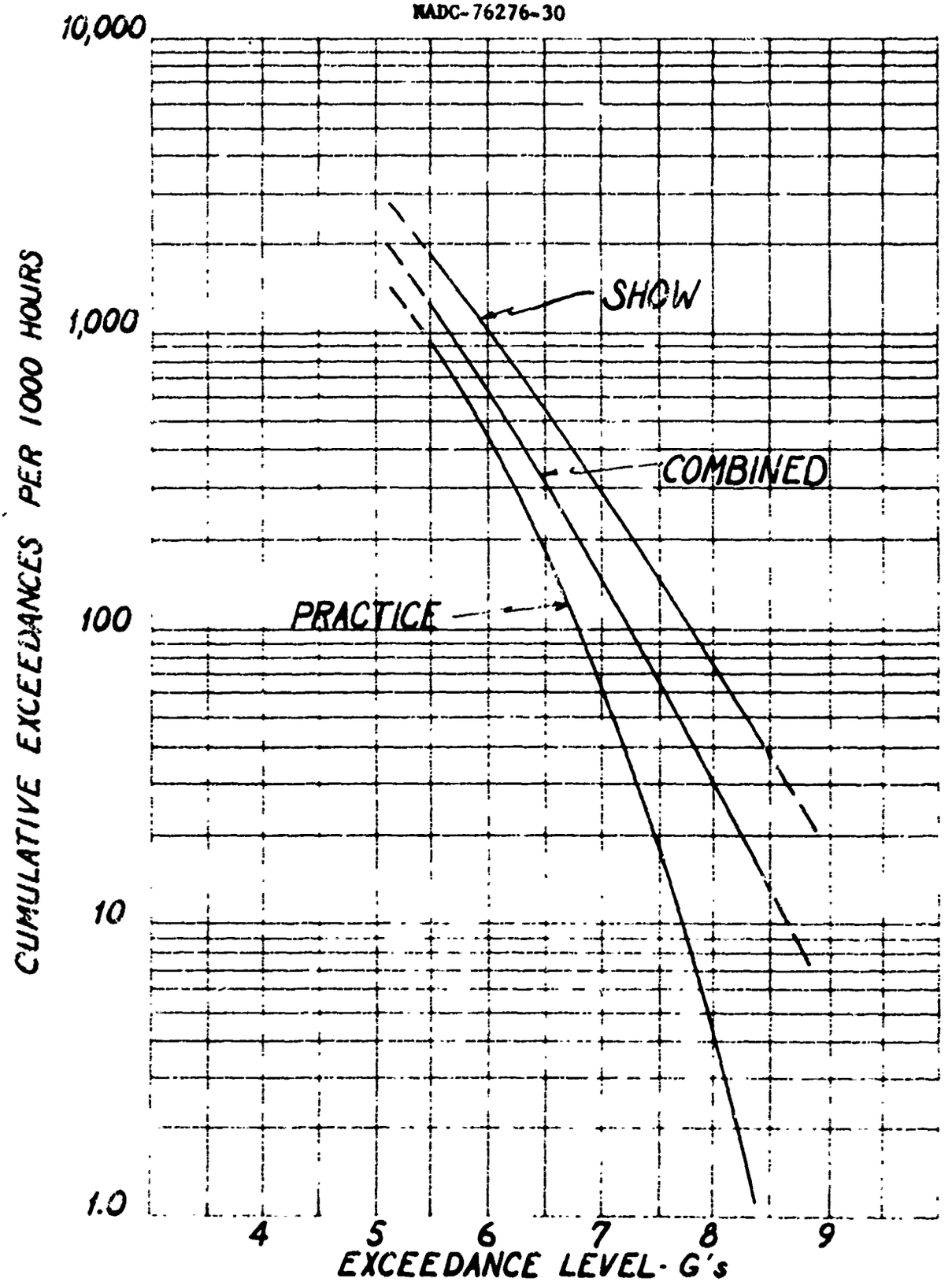

Figure 6. Blue Angel 1974 Counting Accelerometer Rates Per 1000 Hours - Diamond Aircraft

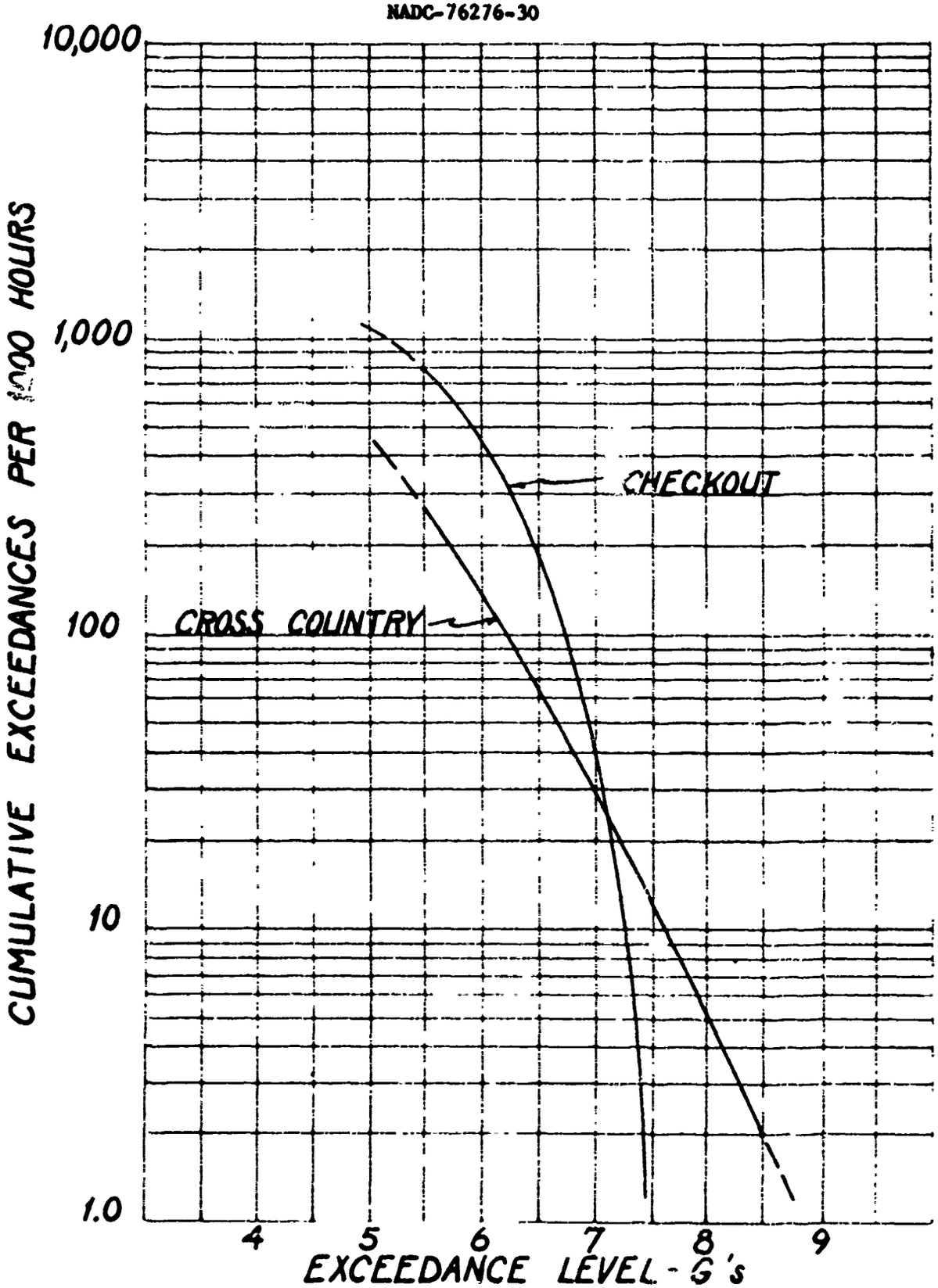

Figure 7. Blue Angel 1974 Counting Accelerometer Rates per 1000 Hours - Cross Country - Checkout

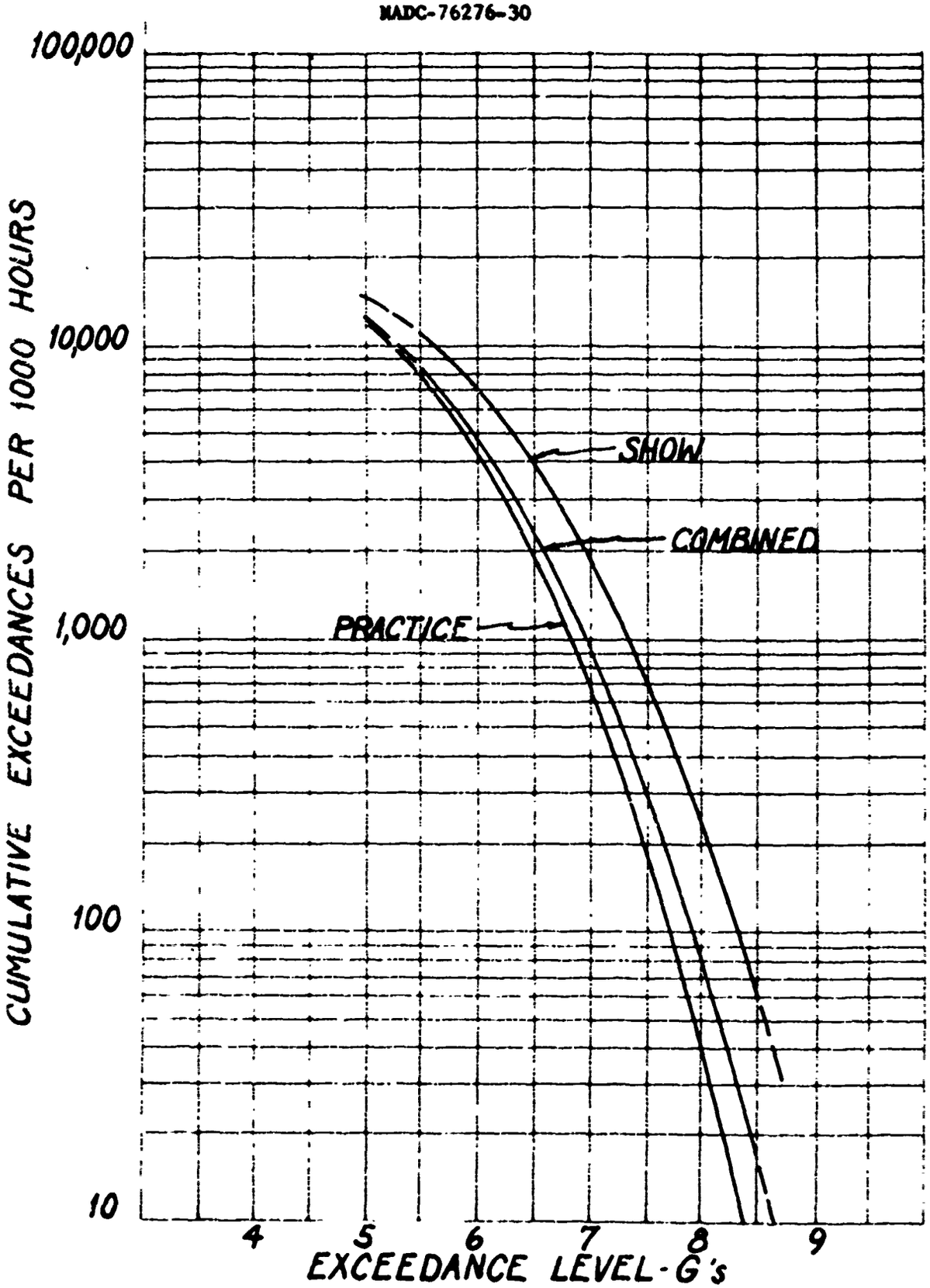

Figure 8. Blue Angel 1975 Counting Accelerometer Rates Per 1000 Hours - Solo Aircraft

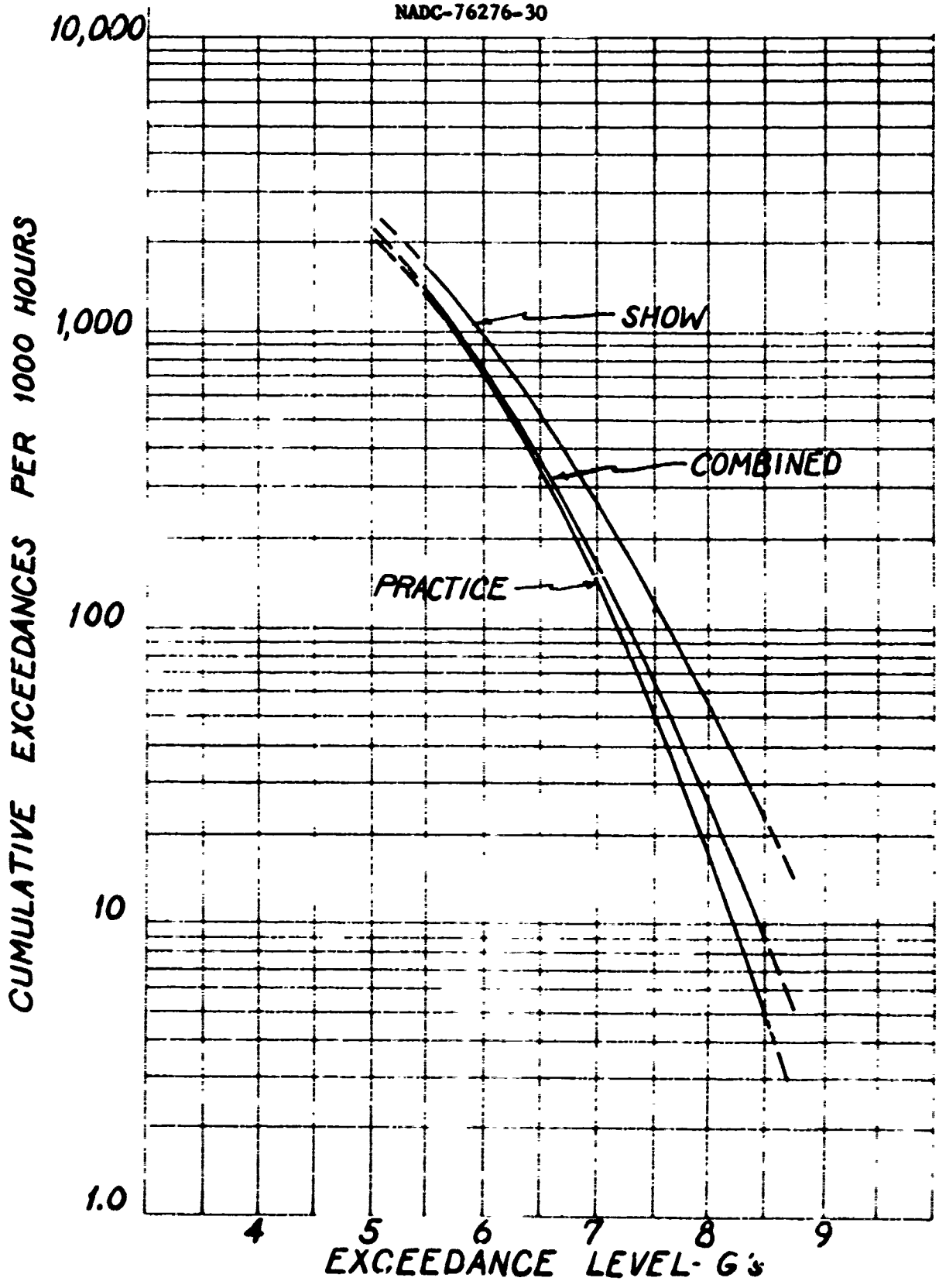

Figure 9. Blue Angel 1975 Counting Accelerometer Rates per 1000 Hours - Diamond Aircraft

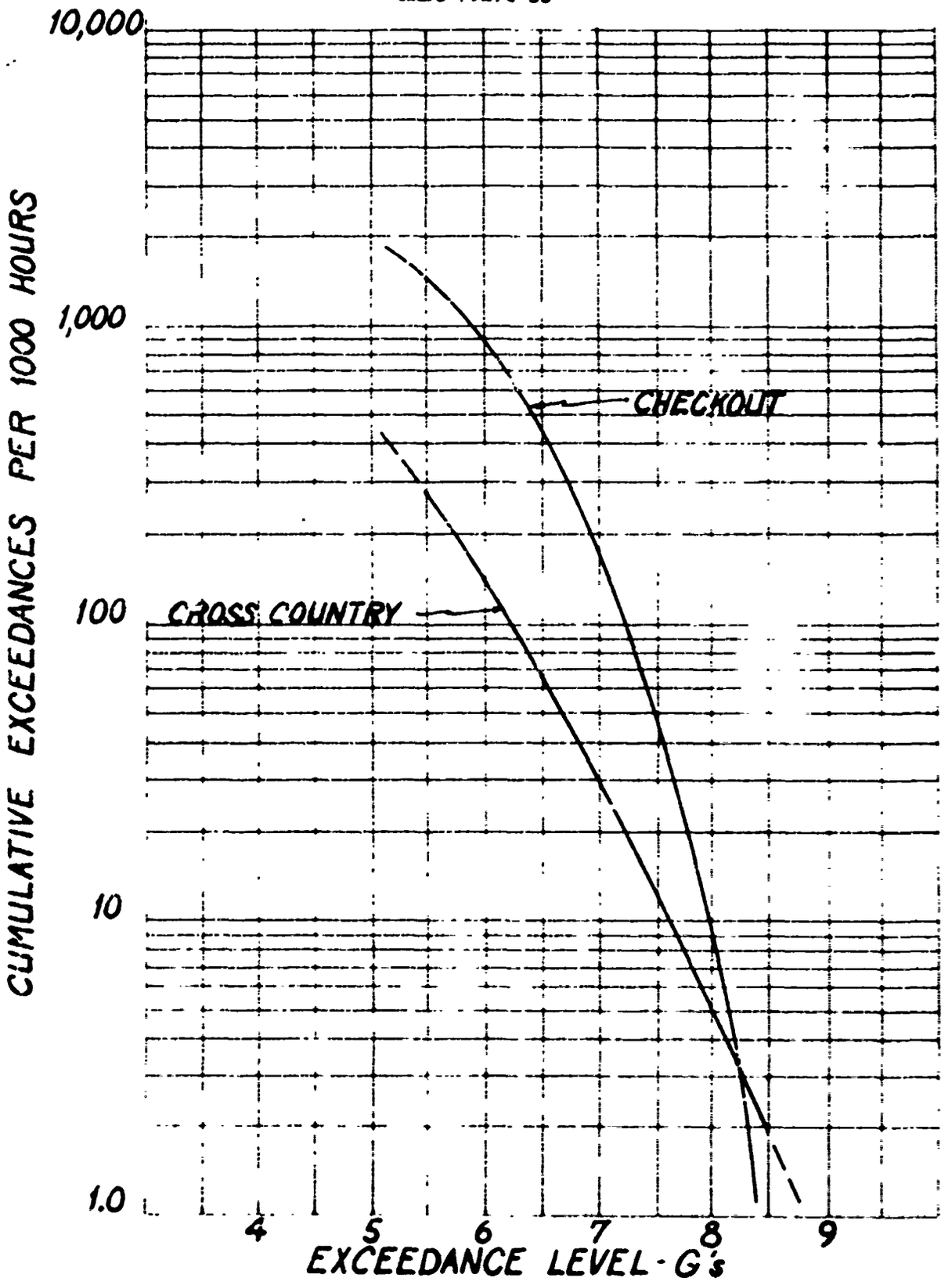

Figure 10. Blue Angel 1975 Counting Accelerometer Rates Per 1000 Hours - Cross Country - Checkout

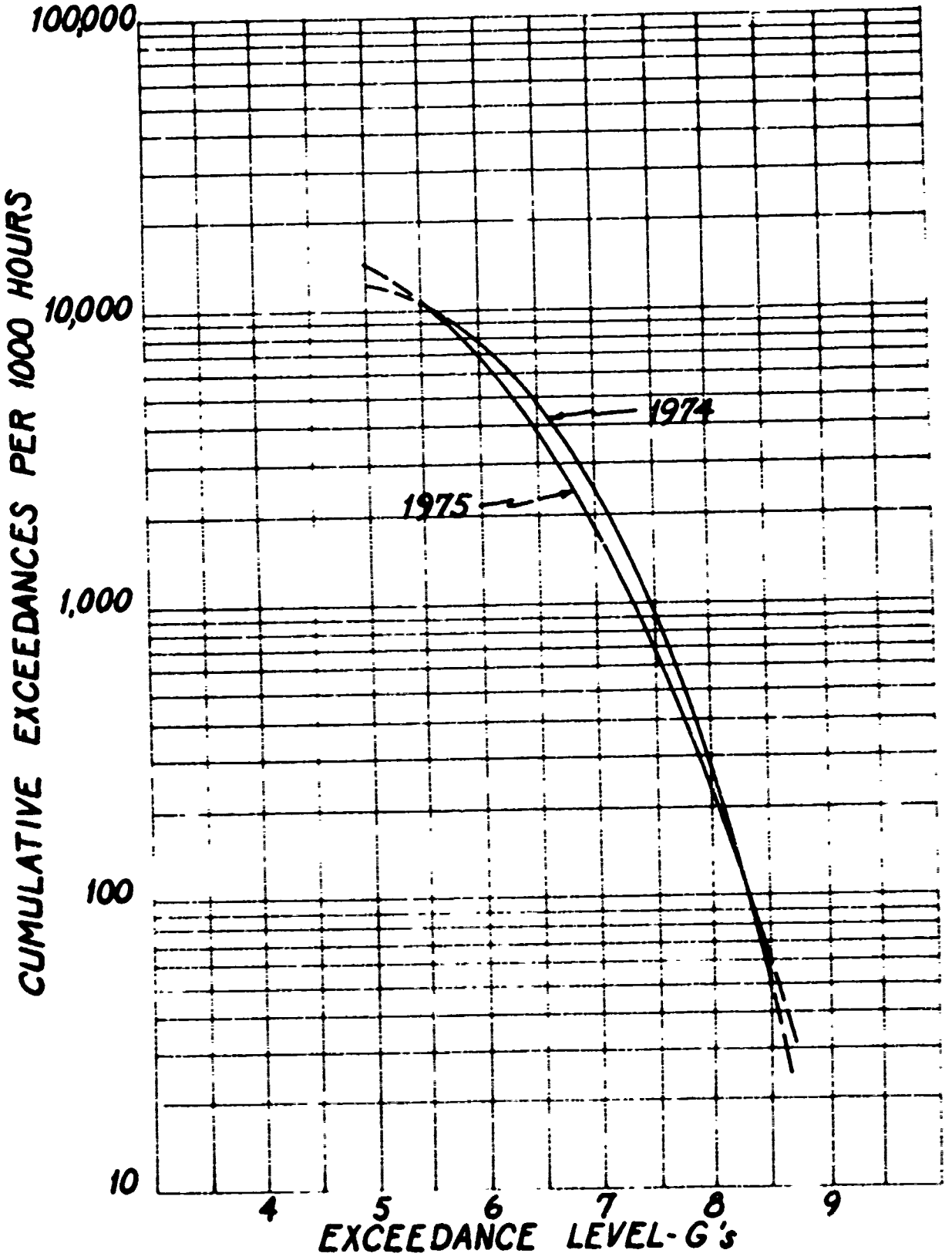

FIGURE 11. 1974 vs. 1975 Blue Angel Counting Accelerometer Rates Per 1000 Hours - Solo Show

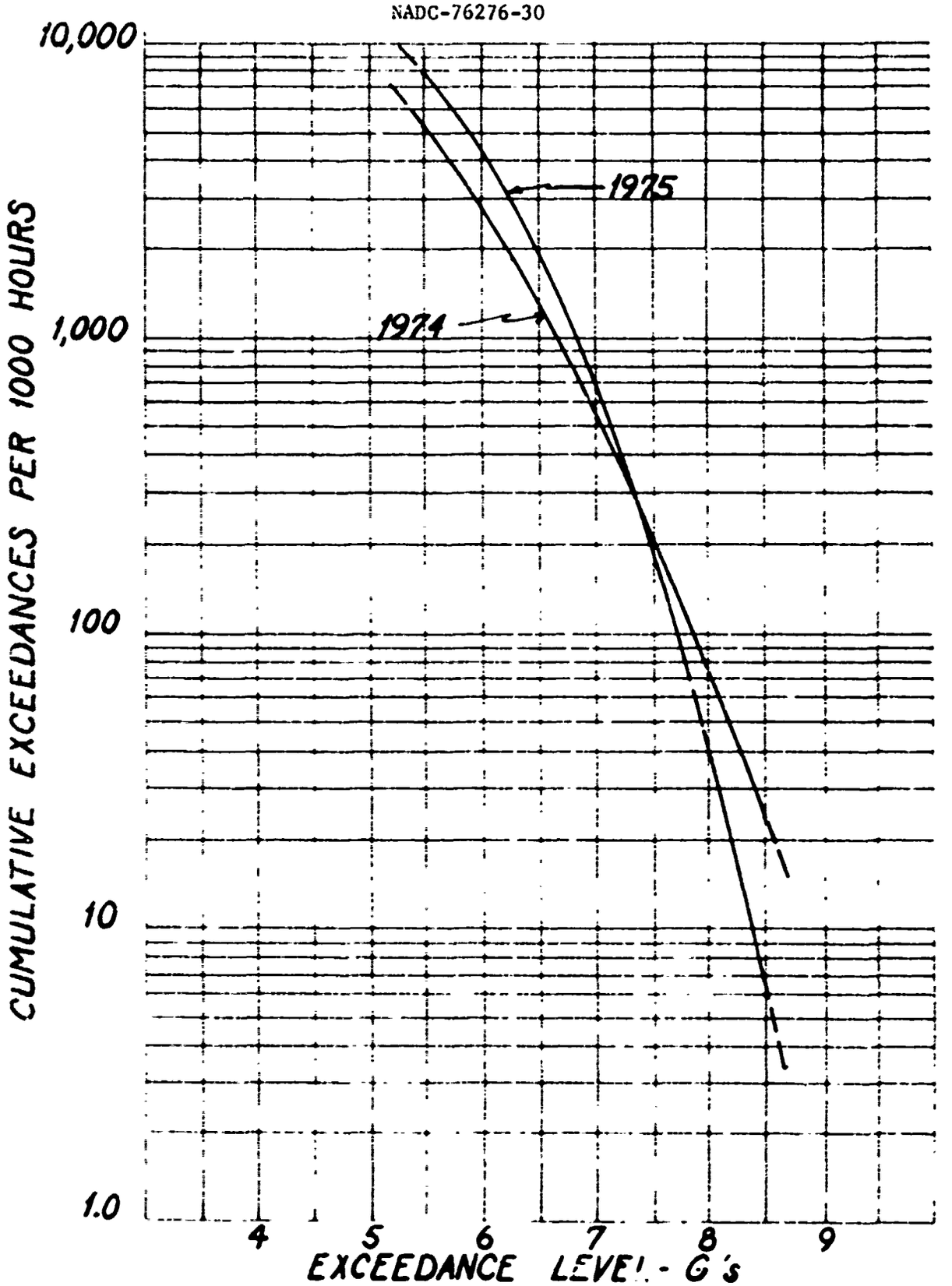

FIGURE 12. 1974 vs. 1975 Blue Angel Counting Accelerometer Rates Per 1000 Hours - Solo Practice

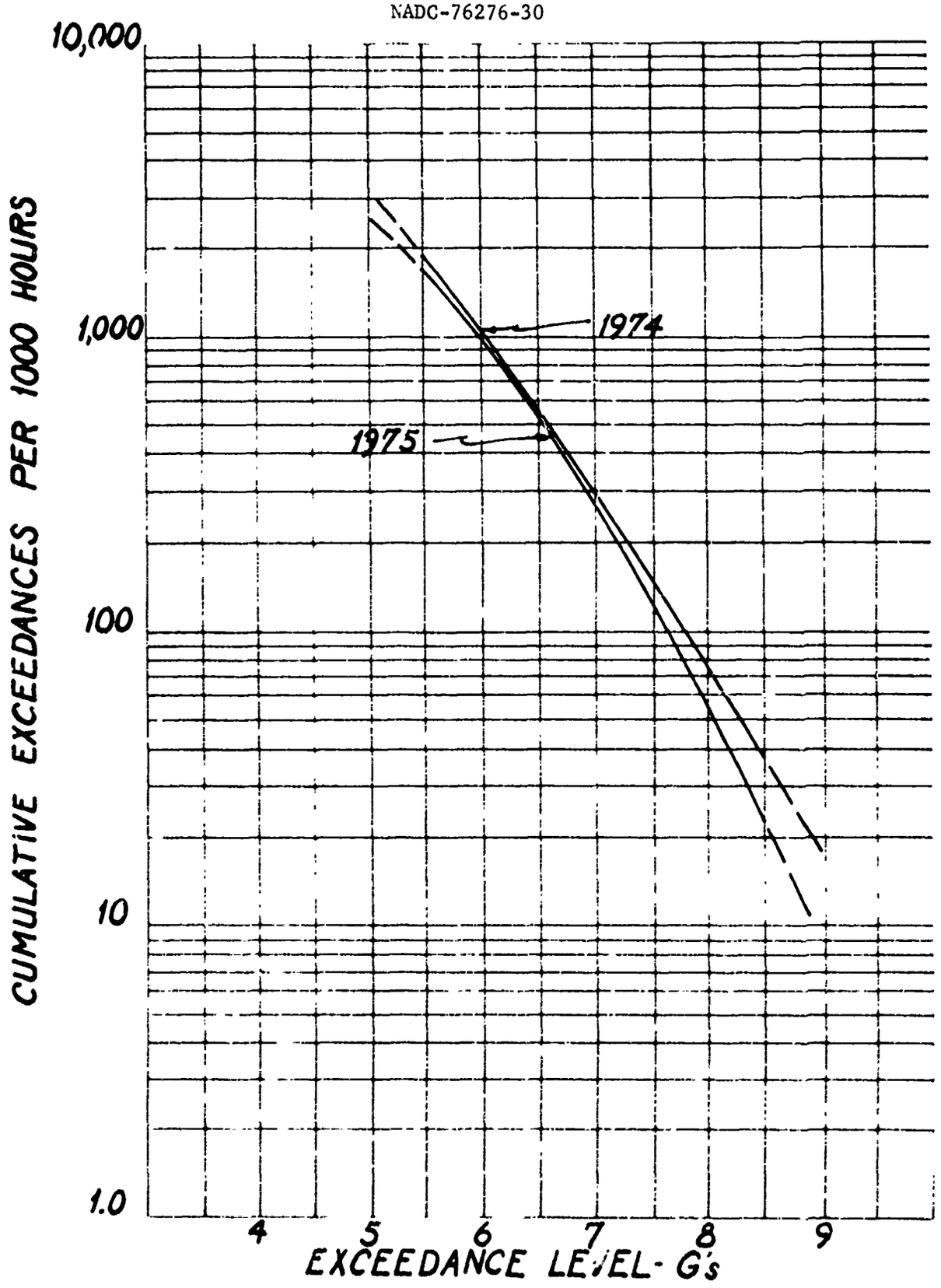

FIGURE 13. 1974 vs. 1975 Blue Angel Counting Accelerometer Rates Per 1000 Hours - Diamond Show

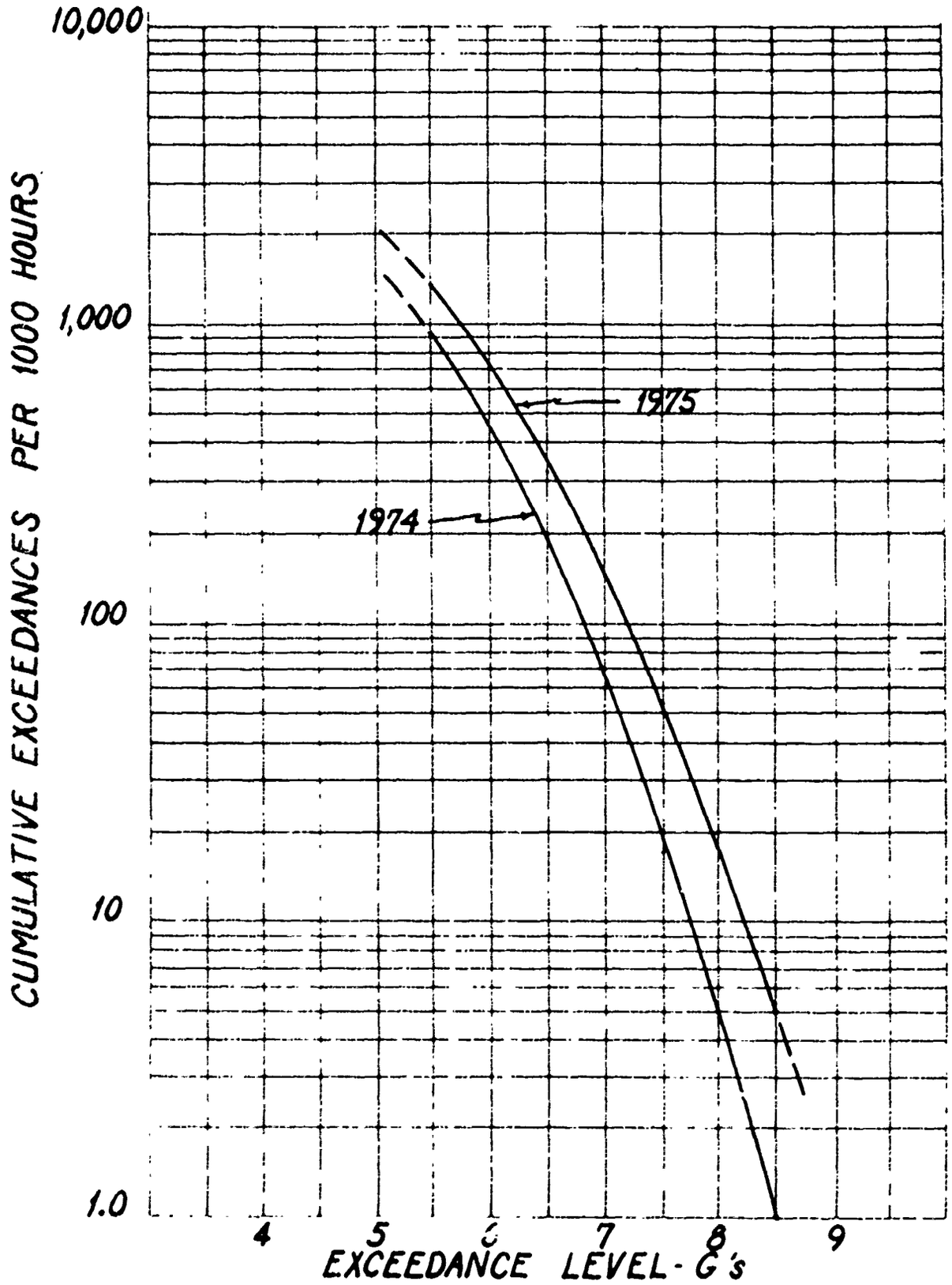

FIGURE 14. 1974 vs. 1975 Blue Angel Counting Accelerometer Rates Per 1000 Hours - Diamond Practice

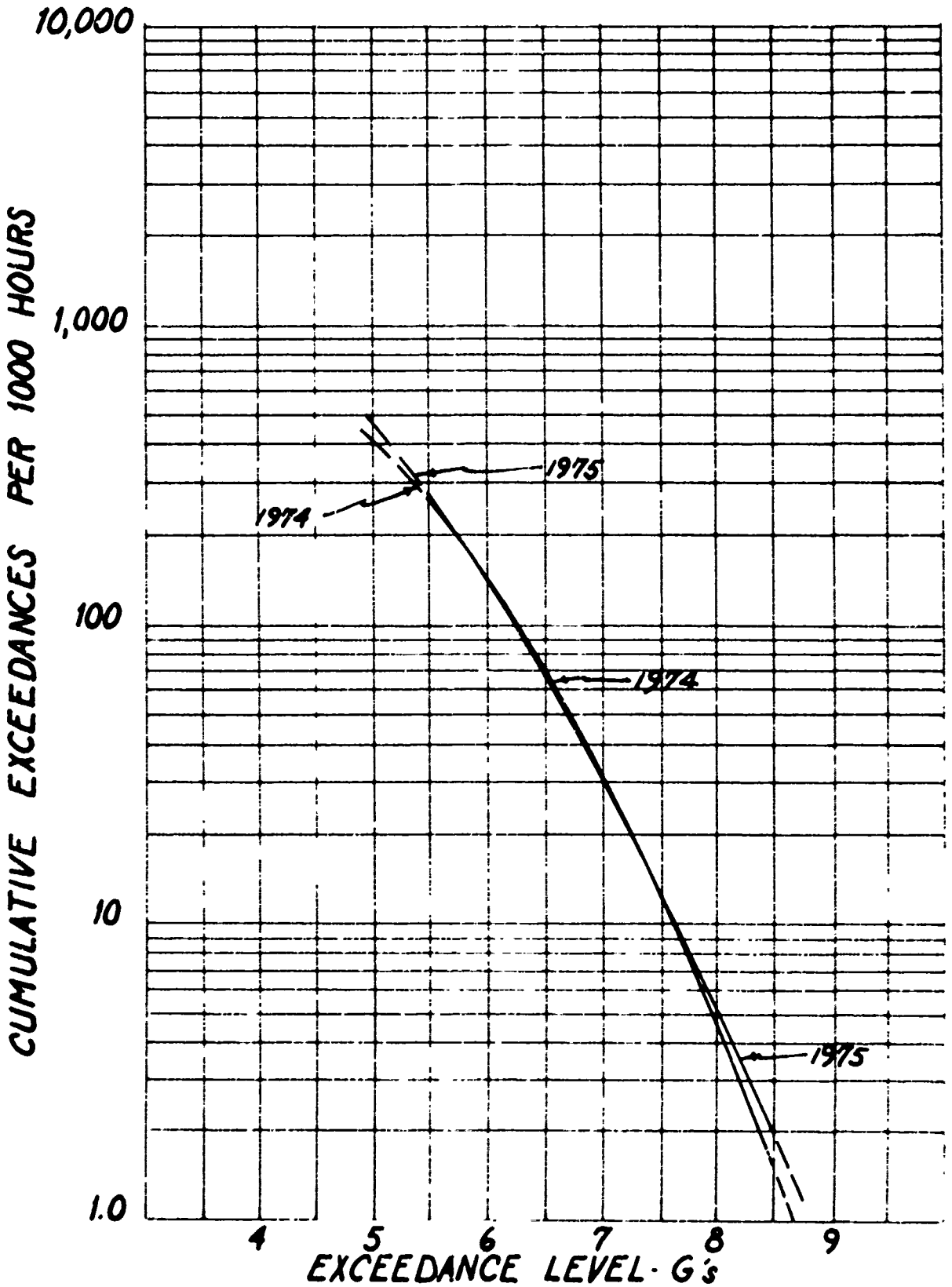

FIGURE 15. 1974 vs. 1975 Blue Angel Counting Accelerometer Rates Per 1000 Hours - Cross Country

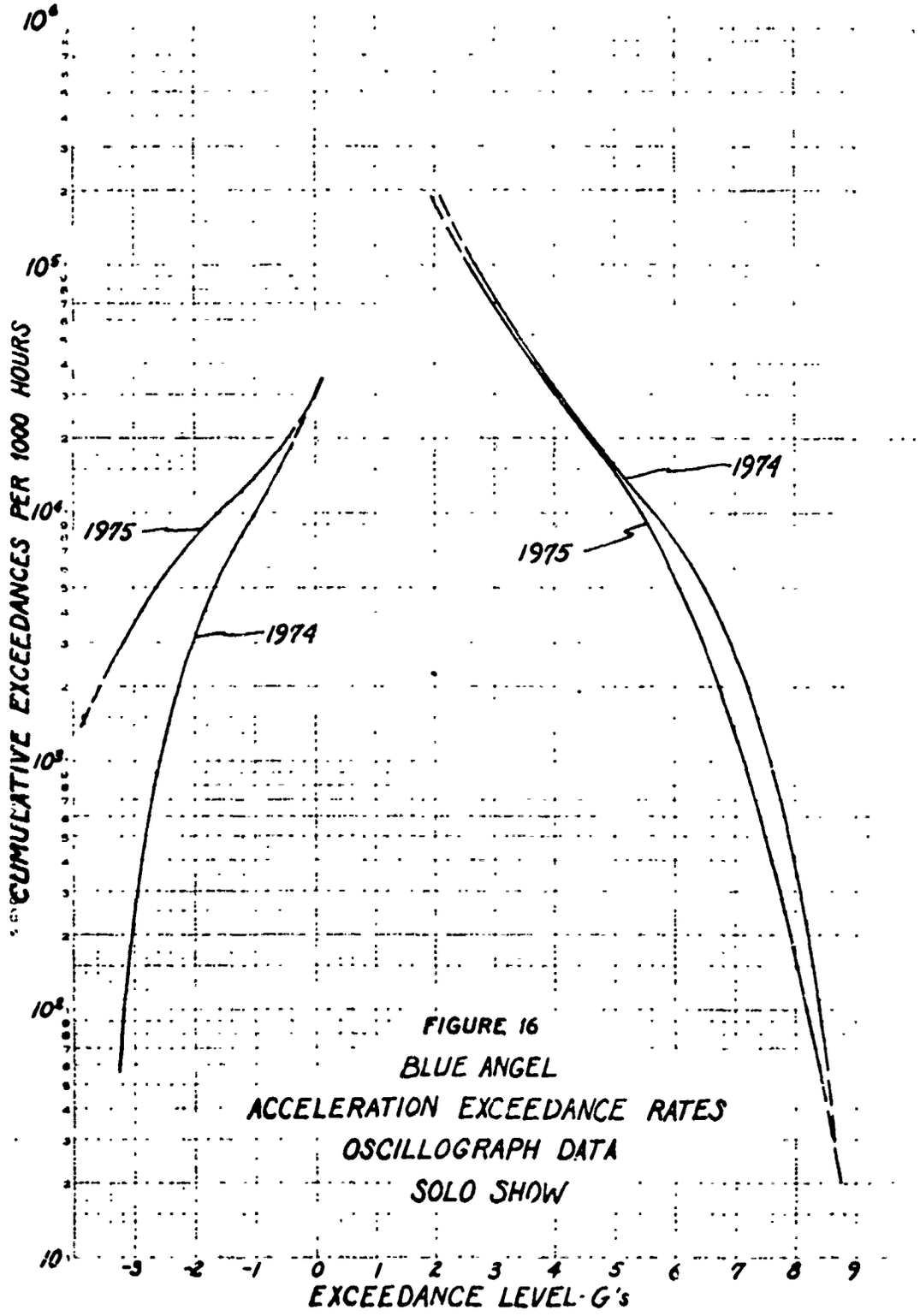

FIGURE 16

BLUE ANGEL

ACCELERATION EXCEEDANCE RATES

OSCILLOGRAPH DATA

SOLO SHOW

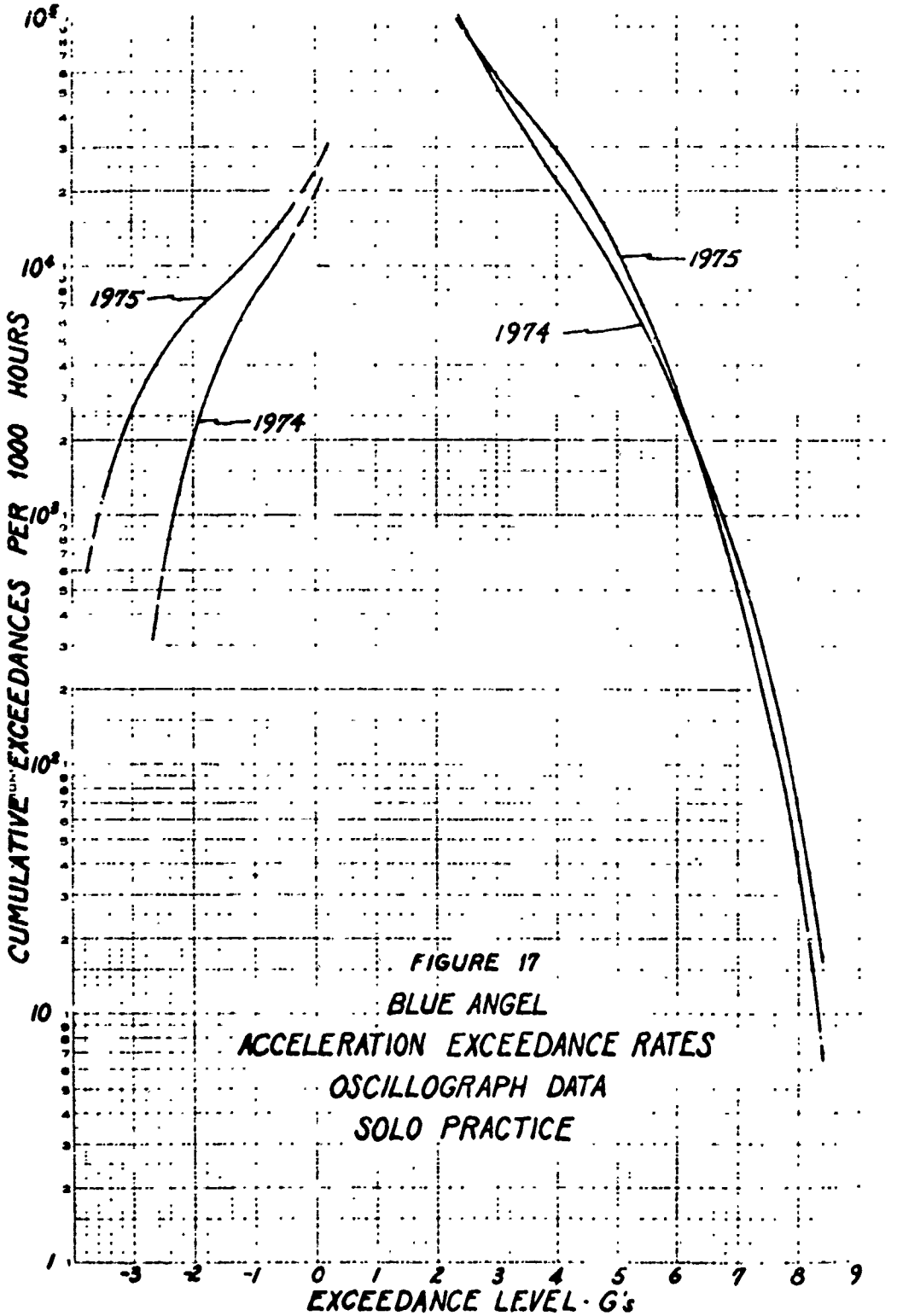

FIGURE 17
BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
OSCILLOGRAPH DATA
SOLO PRACTICE

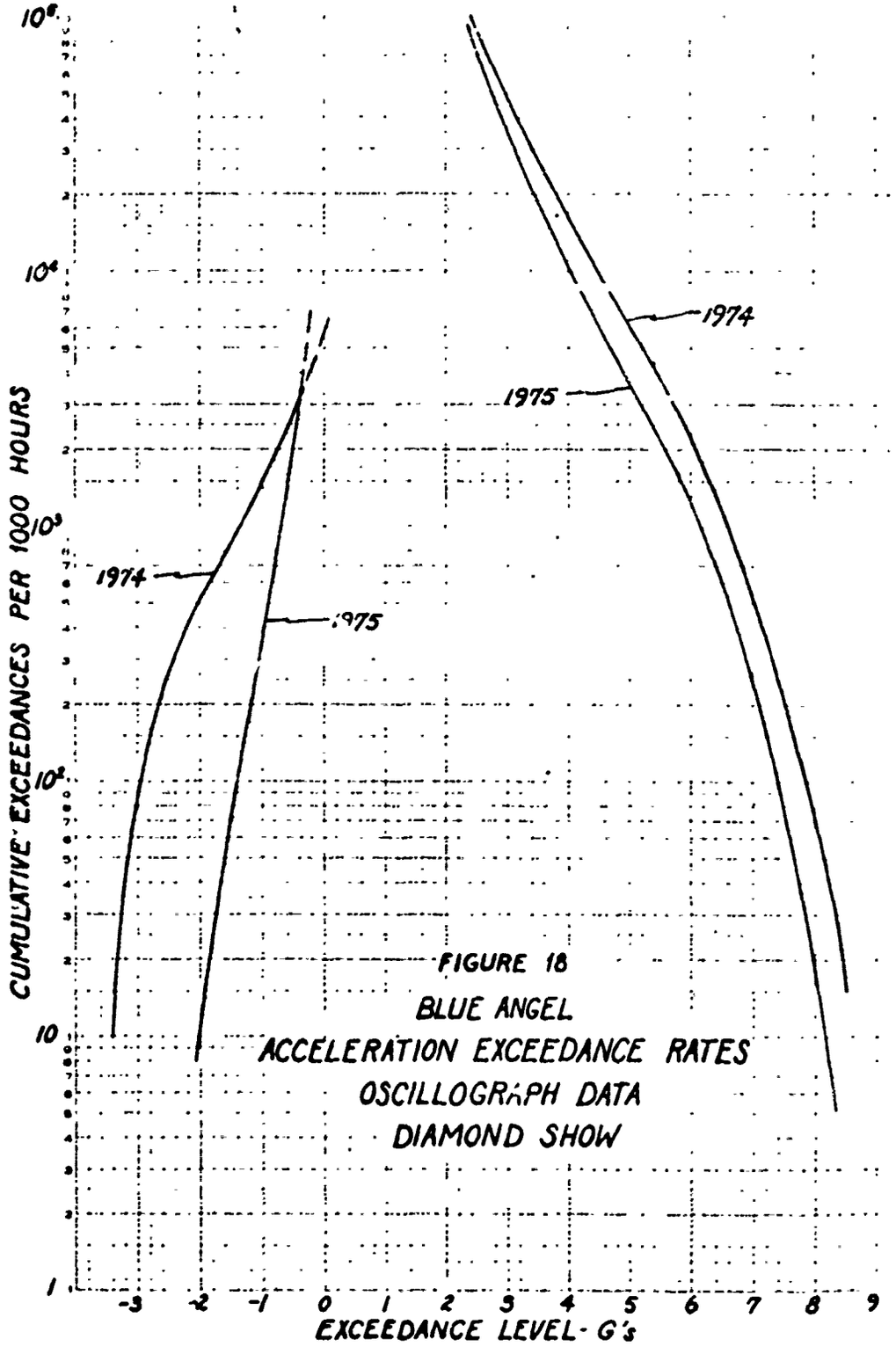

FIGURE 18

BLUE ANGEL

ACCELERATION EXCEEDANCE RATES

OSCILLOGRAPH DATA

DIAMOND SHOW

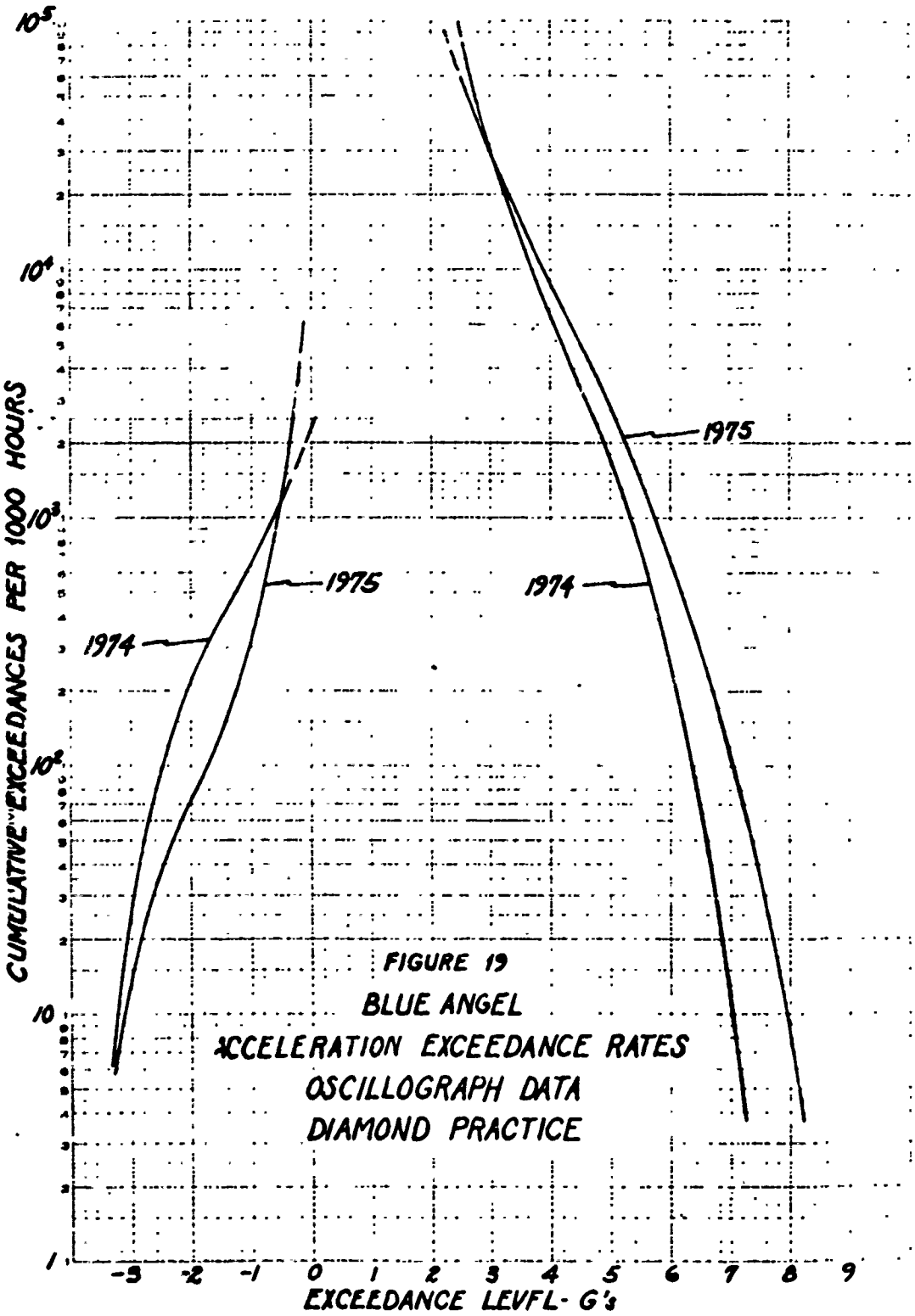

FIGURE 19
BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
OSCILLOGRAPH DATA
DIAMOND PRACTICE

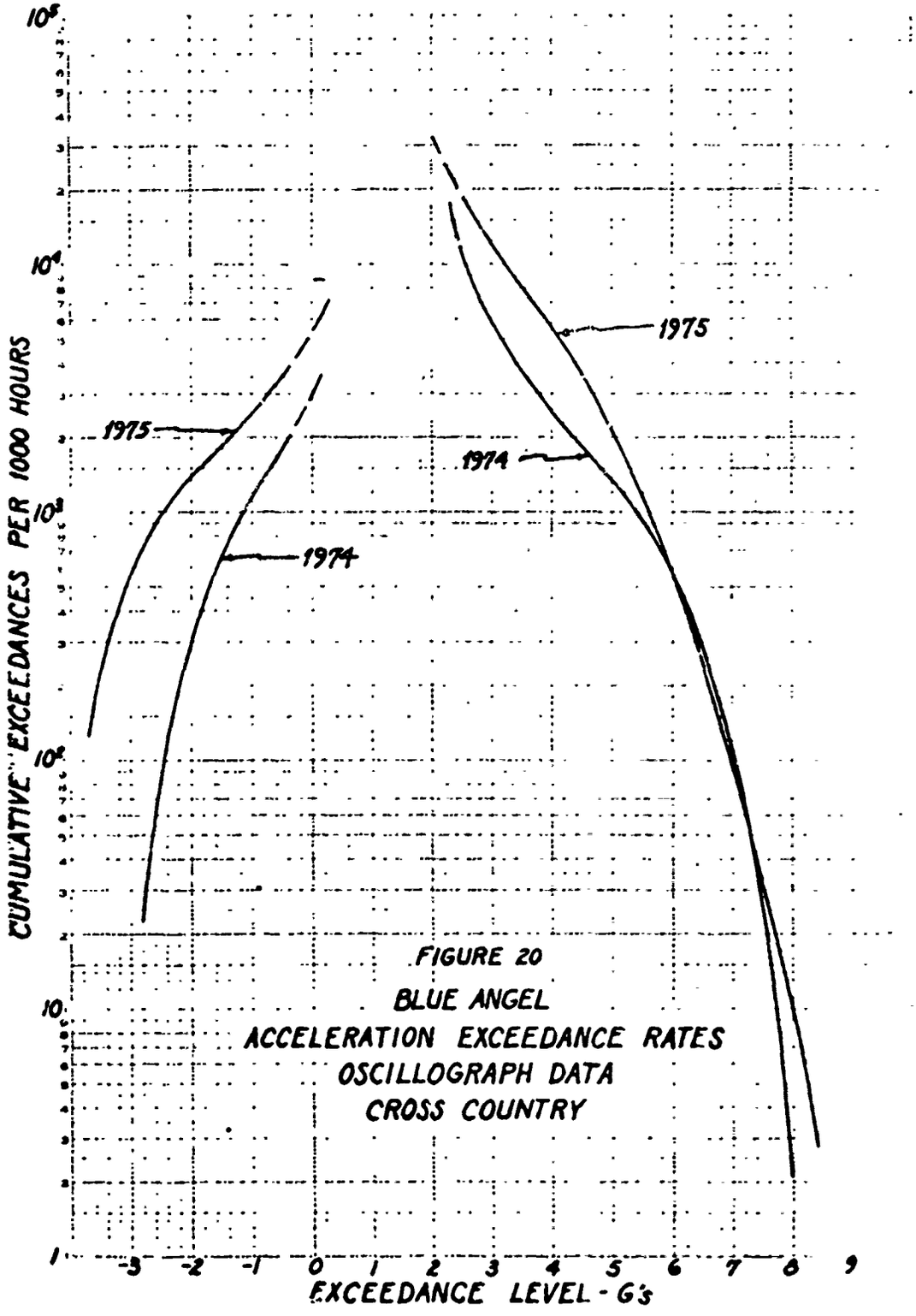

FIGURE 20
BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
OSCILLOGRAPH DATA
CROSS COUNTRY

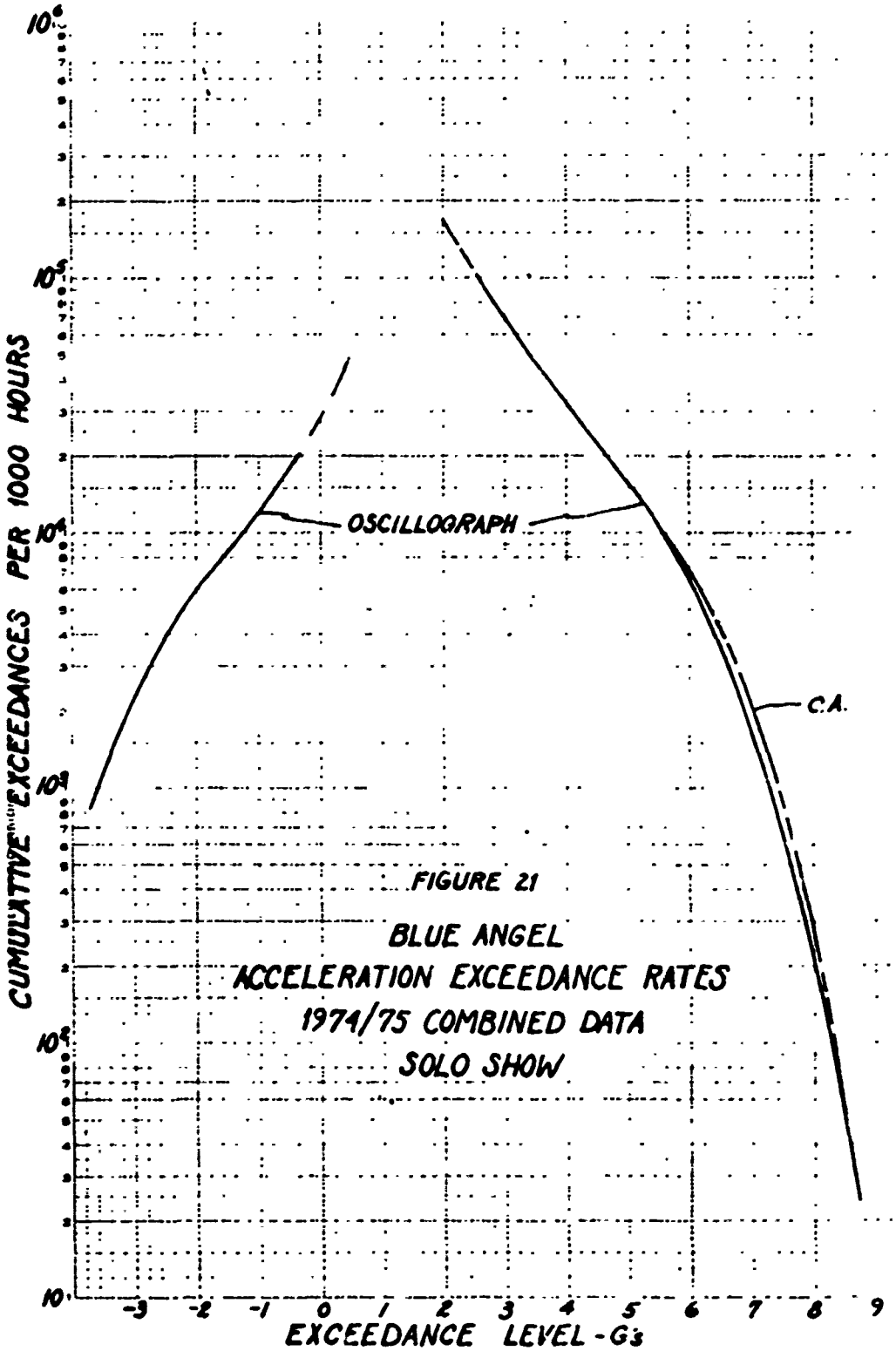

FIGURE 21

BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
1974/75 COMBINED DATA
SOLO SHOW

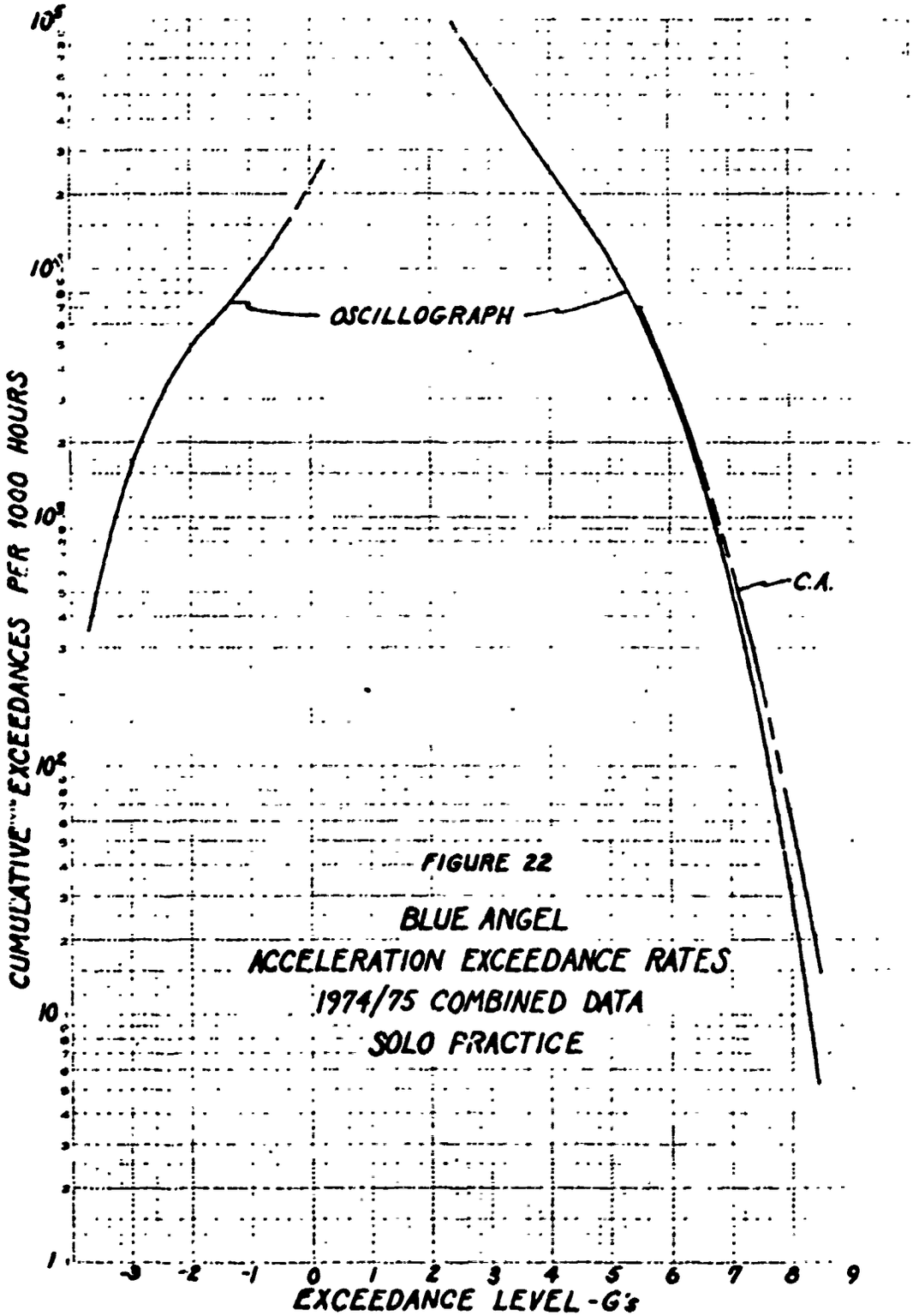

FIGURE 22

BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
1974/75 COMBINED DATA
SOLO PRACTICE

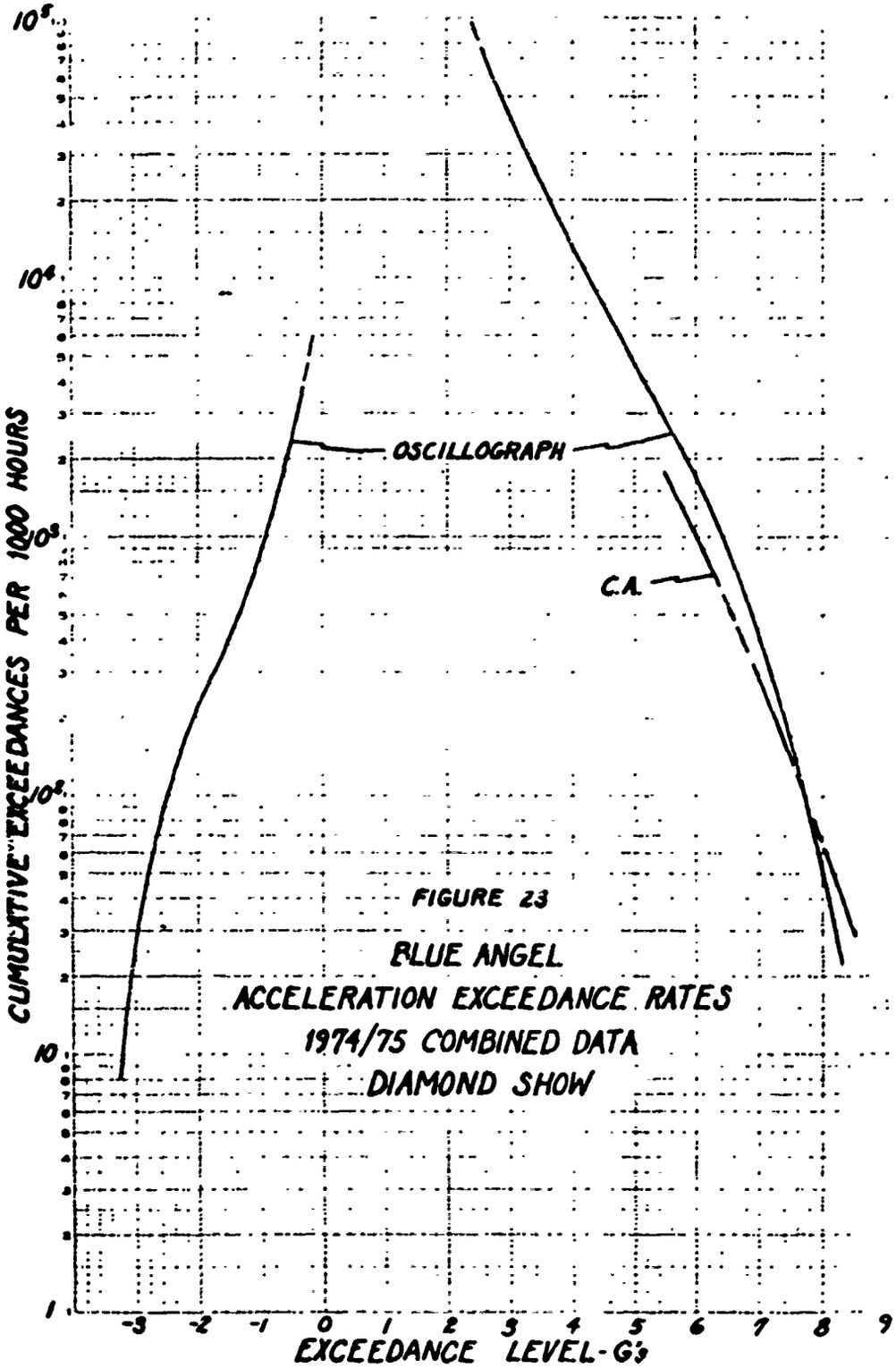

FIGURE 23

BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
1974/75 COMBINED DATA
DIAMOND SHOW

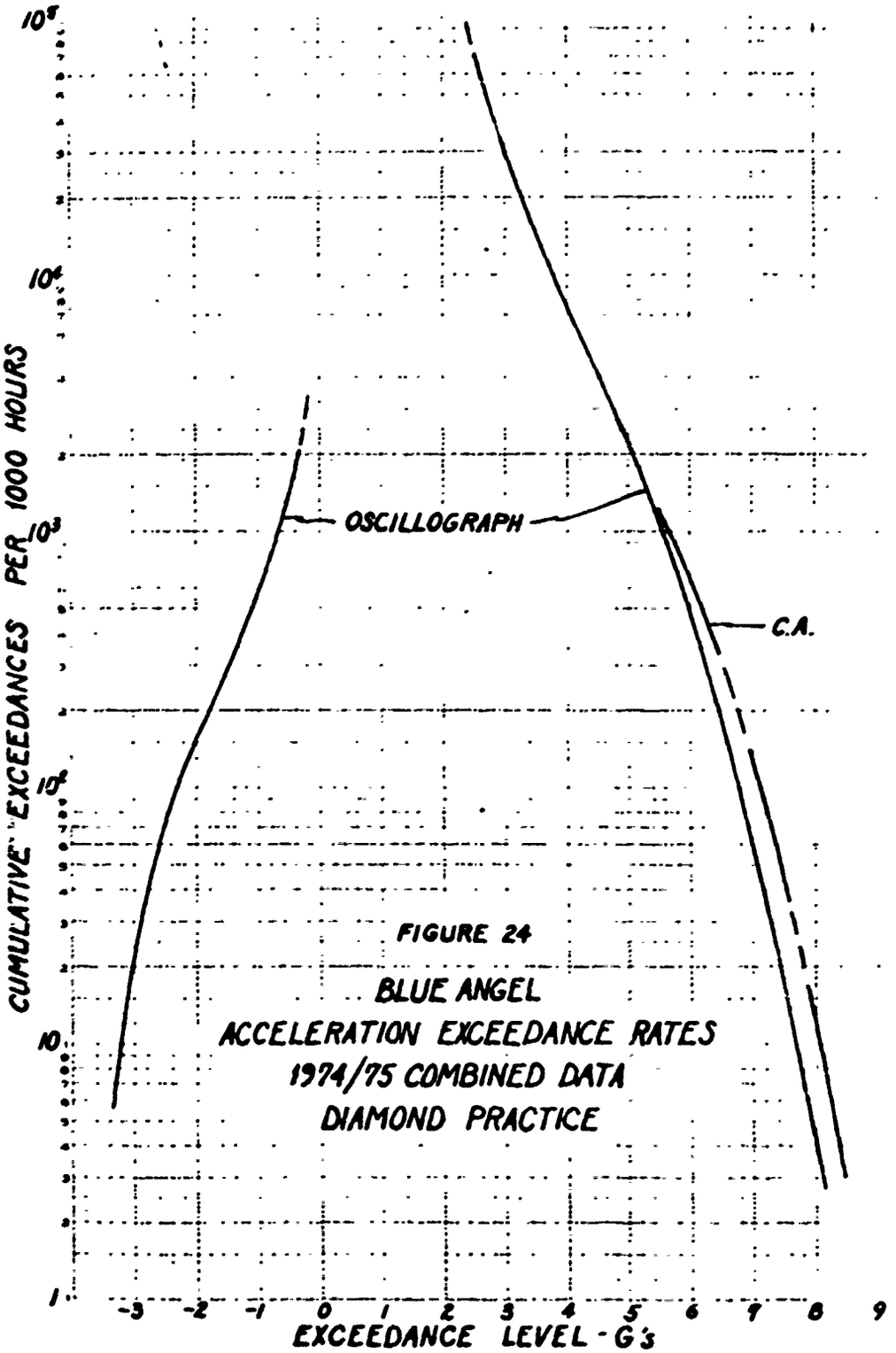

FIGURE 24

BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
1974/75 COMBINED DATA
DIAMOND PRACTICE

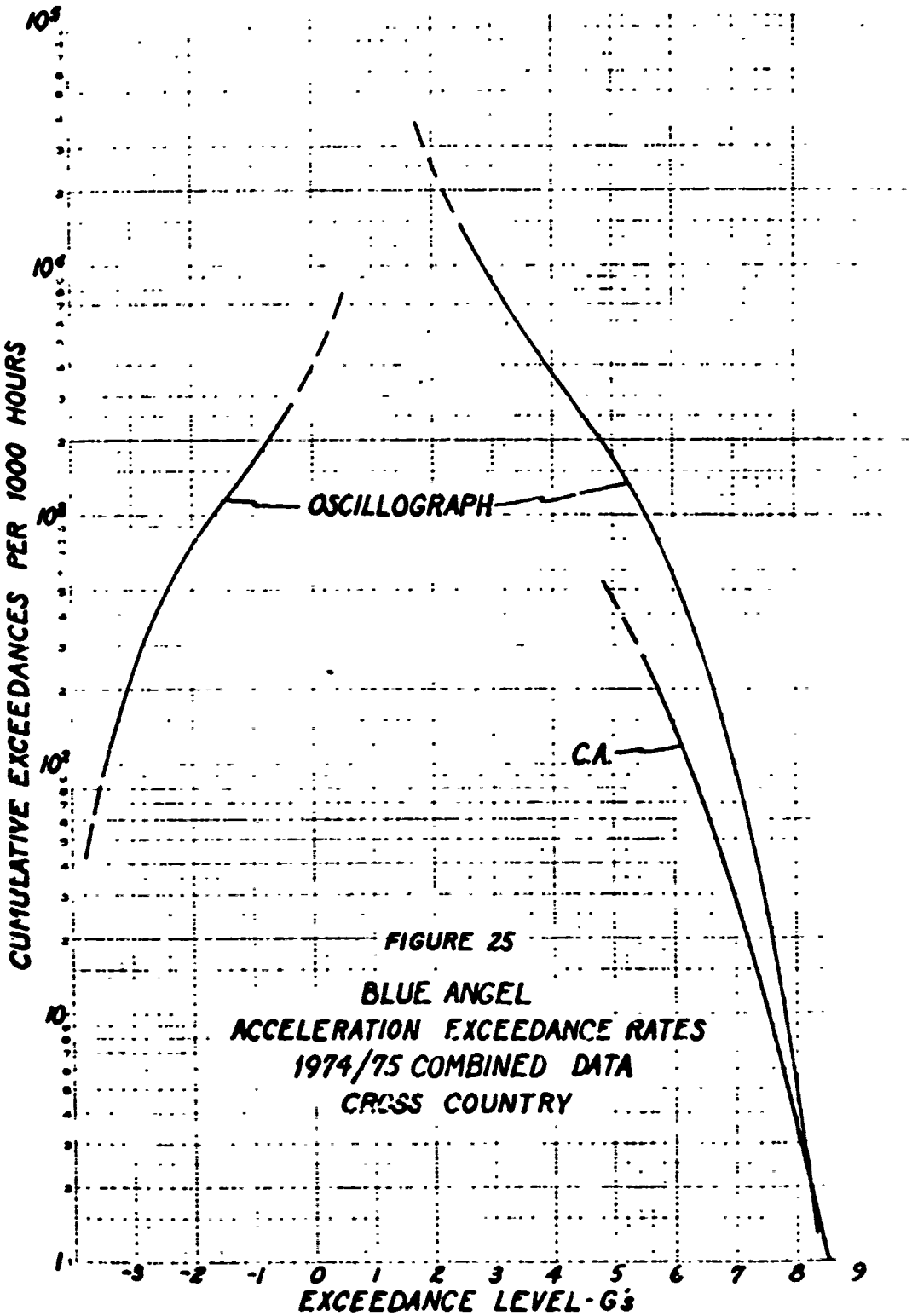

FIGURE 25

BLUE ANGEL
ACCELERATION EXCEEDANCE RATES
1974/75 COMBINED DATA
CROSS COUNTRY

TABLE I

1974-1975
BLUE ANGEL PILOTS AND AIRCRAFT POSITION HISTORY

AIRCRAFT POSITION	1974	1975
1	CDR. A. LESS	CDR. A. LESS
2	LCDR. M. WIITA	CAPT. W. HOLVERSTOTT
3	LT. J. CHEMANSKY	LT. J. PATTON
4	CAPT. J. FOGG	LT. J. CHEMANSKY
5	LT. J. TUCKER	LT. V. PARKER
6	LT. V. PARKER	LT. D. SAPP
7 (narrator)	LT. J. PATTON	LT. A. CISNEROS

AIRCRAFT SERIAL NO.	1974 J	F	M	A	M	J	J	A	S	O	N	D	1975 J	F	M	A	M	J	J	A	S	O	N	D
154176	-	-	8*	8	8	8	4/2	2/8	8	8	8	-	S**	S	6	6	6	6	6	6	6	6	6	-
154177	-	-	9*	9	9/1	1/5	5/9	9/6	6	6	6	-	-	D/S	8	8	8/2	2	2	2	2	2	2	-
154179	-	-	6	6		6	6	6/3	9	9	9	-	D**	D	3	3	3	3	3	3	3	3	*	-
154975	-	-	3	3	3	3	3	3/9	3	3	3	-	D	D	4	4	4	4	4	4	4	4	-	-
154983	-	-	2	2	2	2	2/8	8/2	2	2	2	-	D	D/S	9	9	9/1	1	1	1	1	1	1	-
154984	-	-	1	1	1/9	1/9	1	1	1	1	1	-	D	D/S	1	1	1/9	5	5	5/9	9	9	9	-
154986	-	-	4	4	4	4	8/4	4	4	4	4	-	D	D	2	2	2/8	8	8	8	8	8	3	-
155029	-	-	5	5	5	5/9	9/5	5	5	5	5	-	S	S/-	5	5	5	9	9	9/5	5	5	5	-

* 08, 09 - SPARES
** S - SOLO, D - DIAMOND

TABLE II
1974

BLUE ANGEL COUNTING ACCELEROMETER DATA SUMMARY

SERIAL NUMBER	FLIGHT HOURS TOTAL	FLIGHT HOURS BLUE ANGEL	FLIGHT HOURS ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	EXCEEDANCES 6	EXCEEDANCES 7	EXCEEDANCES 8
154176	1912.8	203.3	156.0	142	23	1	1
154177	2409.1	340.1	228.0	723	372	103	7
154179	2279.9	300.3	160.2	490	131	16	2
154975	2941.8	280.5	244.3	160	15	1	0
154983	2440.7	371.3	245.6	92	59	9	0
154984	2164.8	365.5	245.8	93	5	0	0
154986	1744.9	271.6	258.7	288	81	27	7
155029	1982.5	286.2	243.5	932	237	19	0
		2418.8	1782.1				

TABLE III

1975

BLUE ANGEL COUNTING ACCELEROMETER DATA SUMMARY

SERIAL NUMBER	FLIGHT HOURS TOTAL	FLIGHT HOURS BLUE ANGEL	FLIGHT HOURS ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	EXCEEDANCES 6	EXCEEDANCES 7	EXCEEDANCES 8
154176	2307.1	394.3	325.7	2065	599	43	0
154177	2736.9	327.8	302.5	352	69	16	4
154179	2692.9	413.0	413.0	507	131	25	1
154975	3351.8	410.0	410.0	509	151	22	1
154983	2725.9	285.2	285.2	149	32	1	0
154984	2490.0	325.2	325.2	447	104	17	0
154986	2001.9	257.0	257.0	421	132	22	6
155029	2267.8	285.3	285.3	1492	426	58	7
		2697.8	2603.9				

TABLE IV

1974 COUNTING ACCELEROMETER UTILIZATION SUMMARY

SERIAL NUMBER	SOLO SHOW ACCEPTABLE HOURS	SOLO SHOW CUMULATIVE EXCEEDANCES 5	6	7	8	SOLO PRACTICE ACCEPTABLE HOURS	SOLO PRACTICE CUMULATIVE EXCEEDANCES 5	6	7	8	CROSS COUNTRY ACCEPTABLE HOURS	CROSS COUNTRY CUMULATIVE EXCEEDANCES 5	6	7	8
154176	0.7	15	5	0	0	14.1	37	3	0	0	83.1	23	5	1	1
154177	33.8	426	242	70	3	24.9	191	94	27	4	122.6	68	24	4	0
154179	25.6	242	97	11	2	41.4	194	25	3	0	65.8	32	6	2	0
154975	-	-	-	-	-	-	-	-	-	-	108.9	5	0	0	0
154983	-	-	-	-	-	3.4	0	0	0	0	99.1	3	2	0	0
154984	-	-	-	-	-	-	-	-	-	-	113.3	6	0	0	0
154986	-	-	-	-	-	-	-	-	-	-	118.8	6	2	1	0
155029	41.7	383	136	10	0	83.6	456	75	8	0	106.2	75	18	0	0
TOTALS	101.8	1066	480	91	5	167.4	878	197	38	4	817.8	218	57	8	1
RATES PER 1000 HOURS		10472	4716	894	50		5245	1177	228	24		267	70	10	2

TABLE IV

1974 COUNTING ACCELEROMETER UTILIZATION SUMMARY

SERIAL NUMBER	DIAMOND SHOW ACCEPTABLE HOURS	DIAMOND SHOW CUMULATIVE EXCEEDANCES 5	6	7	8	DIAMOND PRACTICE ACCEPTABLE HOURS	DIAMOND PRACTICE CUMULATIVE EXCEEDANCES 5	6	7	8	CHECKOUT ACCEPTABLE HOURS	CHECKOUT CUMULATIVE EXCEEDANCES 5	6	7	8
154176	11.6	24	5	0	0	15.8	24	3	0	0	11.2	10	2	0	0
154177	9.7	7	0	0	0	21.2	16	2	0	0	6.1	8	3	0	0
154179	1.7	4	0	0	0	2.0	1	0	0	0	4.4	10	1	0	0
154975	47.2	94	8	1	0	77.5	81	7	0	0	4.6	0	0	0	0
154983	38.5	39	27	6	0	84.2	50	30	3	0	7.8	0	0	0	0
154984	40.9	22	0	0	0	81.9	60	5	0	0	6.5	5	0	0	0
154986	42.6	166	55	23	7	83.0	105	23	3	0	2.5	0	0	0	0
155029	-	-	-	-	-	1.2	4	1	0	0	6.3	6	3	0	0
TOTALS	192.2	356	95	30	7	366.8	341	71	6	0	49.4	39	9	0	0
RATES PER 1000 HOURS		1853	495	157	37		930	194	17	0		790	183	0	0

TABLE V

1975 COUNTING ACCELEROMETER UTILIZATION SUMMARY

SERIAL NUMBER	SOLO SHOW ACCEPTABLE HOURS	SOLO SHOW CUMULATIVE EXCEEDANCES 5	6	7	8	SOLO PRACTICE ACCEPTABLE HOURS	SOLO PRACTICE CUMULATIVE EXCEEDANCES 5	6	7	8	CROSS COUNTRY ACCEPTABLE HOURS	CROSS COUNTRY CUMULATIVE EXCEEDANCES 5	6	7	8
154176	46.0	541	202	13	0	142.1	1394	369	28	0	125.9	122	27	2	0
154177	-	-	-	-	-	23.2	163	23	0	0	122.7	7	1	0	0
154179	-	-	-	-	-	5.2	18	10	4	1	149.1	13	3	1	0
154975	-	-	-	-	-	6.7	60	24	6	0	151.3	10	1	0	0
154983	-	-	-	-	-	6.0	43	12	1	0	125.8	1	0	0	0
154984	17.8	134	46	10	0	44.7	191	35	4	0	102.4	24	5	0	0
154986	1.5	16	6	0	0	20.6	132	43	3	0	59.5	5	3	2	2
155029	36.5	387	180	36	6	136.0	1023	218	19	1	102.6	75	22	2	0
TOTALS	101.8	1078	434	59	6		3024	734	65	2	939.3	257	62	7	2
RATES PER 1000 HOURS		10590	4264	580	59		7865	1909	170	6		274	67	8	3

TABLE V

1975 COUNTING ACCELEROMETER UTILIZATION SUMMARY

SERIAL NUMBER	DIAMOND SHOW ACCEPTABLE HOURS	CUMULATIVE EXCEEDANCES 5	6	7	8	DIAMOND PRACTICE ACCEPTABLE HOURS	CUMULATIVE EXCEEDANCES 5	6	7	8	CHECKOUT ACCEPTABLE HOURS	CUMULATIVE EXCEEDANCES 5	6	7	8
154176	-	-	-	-	-	1.3	6	0	0	0	5.0	2	1	0	0
154177	43.1	84	30	12	3	97.6	92	15	4	1	5.1	4	0	0	0
154179	51.6	102	34	8	0	196.0	366	84	12	0	3.7	8	0	0	0
154975	55.2	104	33	4	1	192.3	329	90	12	0	1.9	6	3	0	0
154983	43.6	40	10	0	0	91.9	62	10	0	0	5.4	1	0	0	0
154984	11.7	10	1	0	0	144.8	88	17	3	0	2.2	0	0	0	0
154986	12.7	30	8	1	1	150.7	221	64	16	3	3.3	17	8	0	0
155029	-	-	-	-	-	-	-	-	-	-	5.1	7	6	1	0
TOTALS	217.9	370	116	25	5	874.6	1164	280	47	4	31.7	45	18	1	0
RATES PER 1000 HOURS		1699	533	115	23		1331	321	54	5		1420	568	32	0

TABLE VI

COMBINED 1974-1975

COUNTING ACCELEROMETER UTILIZATION SUMMARY

SERIAL NUMBER	SOLO SHOW ACCEPTABLE HOURS	SOLO SHOW CUMULATIVE EXCEEDANCES 5	6	7	8	SOLO PRACTICE ACCEPTABLE HOURS	SOLO PRACTICE CUMULATIVE EXCEEDANCES 5	6	7	8	CROSS COUNTRY ACCEPTABLE HOURS	CROSS COUNTRY CUMULATIVE EXCEEDANCES 5	6	7	8
154176	46.7	556	207	13	0	156.2	1431	372	28	0	209.0	145	32	3	1
154177	33.8	426	242	70	3	48.1	354	117	27	4	245.3	75	25	4	0
154179	25.6	242	97	11	2	46.6	212	35	7	1	214.9	45	9	3	0
154975	-	-	-	-	-	6.7	60	24	6	0	260.2	15	1	0	0
154983	-	-	-	-	-	9.4	43	12	1	0	224.9	4	2	0	0
154984	17.8	134	46	10	0	44.7	191	35	4	0	215.7	30	5	0	0
154986	1.5	16	6	0	0	70.6	132	43	3	0	178.3	11	5	3	2
155029	78.2	770	316	46	6	219.6	1479	293	27	1	208.8	150	40	2	0
TOTALS	203.6	2144	914	150	11	551.9	3902	931	103	6	1757.1	475	119	15	3
RATES PER 1000 HOURS		10530	4489	736	54		7070	1687	187	11		270	67	8	1

TABLE VI

COMBINED 1974-1975

COUNTING ACCELEROMETER UTILIZATION SUMMARY

SERIAL NUMBER	DIAMOND SHOW ACCEPTABLE HOURS	DIAMOND SHOW CUMULATIVE EXCEEDANCES 5	6	7	8	DIAMOND PRACTICE ACCEPTABLE HOURS	DIAMOND PRACTICE CUMULATIVE EXCEEDANCES 5	6	7	8	CHECKOUT ACCEPTABLE HOURS	CHECKOUT CUMULATIVE EXCEEDANCES 5	6	7	8
154176	11.6	24	5	0	0	17.1	30	3	0	0	16.2	12	3	0	0
154177	52.8	91	30	12	3	118.8	108	17	4	1	11.2	12	3	0	0
154179	53.3	106	34	8	0	198.0	367	84	12	0	8.1	18	1	0	0
154975	102.4	198	41	5	1	269.8	410	97	12	0	6.5	6	3	0	0
154983	82.1	79	37	6	0	176.1	112	40	3	0	13.2	1	0	0	0
154984	52.6	32	1	0	0	226.7	148	22	3	0	8.7	5	0	0	0
154986	55.3	196	63	24	8	233.7	326	87	19	3	5.8	17	8	0	0
155029	-	-	-	-	-	1.2	4	1	0	0	11.4	13	9	1	0
TOTALS	410.1	726	211	55	12	1241.4	1505	351	53	4	81.1	84	27	1	0
RATES PER 1000 HOURS		1770	515	134	29		1212	283	43	3		1035	332	12	0

TABLE VII

OSCILLOGRAPH DATA SUMMARY

YEAR	SERIAL NUMBER	AIRCRAFT POSITION	ACCEPTABLE OSCILLOGRAPH DATA HOURS	DATA PERIOD	TOTAL NO. HOURS
1974	154986	#4(DIAM)	63.02	3/29/74-11/10/74	
1974	155029	#5(SOLO)	35.66	4/5/74-8/25/74	157.1
1974	154179	#6(SOLO)	38.21	3/29/74-7/7/74	
1974	154177	#6(SOLO)	20.21	9/20/74-11/10/74	
1975	154975	#4(DIAM)	97.87	3/1/75-10/29/75	
1975	155029	#5(SOLO)	44.6	4/11/75-10/27/75	278.9
1975	154176	#6(SOLO)	136.43	2/26/75-10/29/75	
			436.0		

TABLE VIII
OSCILLOGRAPH DATA
CUMULATIVE EXCEEDANCE SUMMARY

G LEVEL	1974 154986 (D)	1974 155029 (S)	1974 154177 (S)	1974 154179 (S)	1975 154975 (D)	1975 155029 (S)	1975 154176 (S)
LESS THAN -3.00	0	0	0	0	0	30	165
-2.99 TO -2.00	8	21	23	36	1	94	681
-1.99 TO -1.00	31	149	124	192	5	278	1185
-.99 TO .25	122	479	380	608	286	707	2347
2.00 TO 2.99	5588	3608	1527	4005	4503	2880	10921
3.00 TO 3.99	1530	1569	961	1672	1317	1480	5882
4.00 TO 4.99	384	581	442	673	396	669	2602
5.00 TO 5.99	112	255	225	265	117	269	1082
6.00 TO 6.99	23	84	131	67	31	91	315
7.00 TO 7.99	6	7	42	7	3	16	21
8.00 AND UP	0	0	1	1	0	3	0
HOURS OF DATA	63.02	35.66	20.21	38.21	97.87	44.60	136.43

TABLE IX

OSCILLOGRAPH DATA SUMMARY: PILOT REPORT SHEET MATCH

YEAR	SERIAL NUMBER	AIRCRAFT POSITION	PRACTICE	SHOW	TOTAL	
1974	154986	#4(DIAM)	30.8	19.6	50.4	
1974	155029	#5(SOLO)	10.1	14.3	24.4	
1974	154179	#6(SOLO)	17.6	9.9	27.5	117.4
1974	154177	#6(SOLO)	4.1	11.0	15.1	
1975	154975	#4(DIAM)	25.1	27.8	52.9	
1975	155029	#5(SOLO)	13.8	12.5	26.3	141.4
1975	154176	#6(SOLO)	29.1	33.1	62.2	
			130.6	128.2	258.8	

TABLE X
OSCILLOGRAPH DATA
AIRCRAFT UTILIZATION CUMULATIVE EXCEEDANCE SUMMARY

G LEVEL	1974 154986 DIAM PRAC	1974 154986 DIAM SHOW	1974 155029 SOLO PRAC	1974 155029 SOLO SHOW	1974 154177 SOLO PRAC	1974 154177 SOLO SHOW	1974 154179 SOLO PRAC	1974 154179 SOLO SHOW	1975 154975 DIAM PRAC	1975 154975 DIAM SHOW	1975 155029 SOLO PRAC	1975 155029 SOLO SHOW	1975 154176 SOLO PRAC	1975 154176 SOLO SHOW
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	6	15	43	85
-2.99 TO -2.00	3	5	6	11	6	13	7	18	1	0	32	34	161	221
-1.99 TO -1.00	12	16	28	79	32	71	87	61	3	2	92	93	269	390
-.99 TO .25	32	66	74	256	80	225	264	180	82	111	212	251	537	727
2.00 TO 2.99	2506	1658	674	1837	380	919	1721	1211	1430	1953	955	966	2494	3630
3.00 TO 3.99	497	651	322	779	228	612	668	536	412	616	474	495	1309	1907
4.00 TO 4.99	105	197	109	290	95	285	258	209	129	181	218	223	592	738
5.00 TO 5.99	24	76	44	130	50	142	76	106	37	54	64	123	219	310
6.00 TO 6.99	2	20	9	46	31	88	6	42	7	19	10	49	48	97
7.00 TO 7.99	0	6	0	5	7	34	1	6	1	2	3	8	4	5
8.00 AND UP	0	0	0	0	0	1	0	1	0	0	0	2	0	0
HOURS OF DATA	30.8	19.6	10.1	14.3	4.1	11.0	17.6	9.9	25.1	27.8	13.8	12.5	29.1	33.1

NADC 76276-30

TABLE XI
OSCILLOGRAPH DATA
UTILIZATION CUMULATIVE EXCEEDANCE SUMMARY

G LEVEL	1974 DIAMOND PRACTICE	1974 DIAMOND SHOW	1974 SOLO PRACTICE	1974 SOLO SHOW	1975 DIAMOND PRACTICE	1975 DIAMOND SHOW	1975 SOLO PRACTICE	1975 SOLO SHOW	1974-1975 DIAMOND PRACTICE	1974-1975 DIAMOND SHOW	1974-1975 SOLO PRACTICE	1974-1975 SOLO SHOW
LESS THAN -3.00	0	0	0	0	0	0	49	100	0	0	49	100
-2.99 TO -2.00	3	5	19	42	1	0	193	255	4	5	212	297
-1.99 TO -1.00	12	16	147	211	3	2	361	483	15	18	508	694
-.99 TO .25	32	66	418	661	82	111	749	978	114	177	1167	1639
2.00 TO 2.99	2506	1658	2775	3967	1430	1953	3449	4596	3936	3611	6224	8563
3.00 TO 3.99	497	651	1218	1927	412	616	1783	2402	909	1267	3001	4329
4.00 TO 4.99	105	197	462	784	129	181	810	961	234	378	1272	1745
5.00 TO 5.99	24	76	170	378	37	54	283	433	61	130	453	811
6.00 TO 6.99	2	20	46	176	7	19	58	146	9	39	104	322
7.00 TO 7.99	0	6	8	45	1	2	7	13	1	8	15	58
8.00 AND UP	0	0	0	2	0	0	0	2	0	0	0	4
HOURS OF DATA	30.8	19.6	31.8	35.2	25.1	27.8	42.9	45.6	55.9	47.4	74.7	80.8

NADC 76276-30

TABLE XII
OSCILLOGRAPH DATA
UTILIZATION RATES PER 1000 HOURS

G LEVEL	1974 DIAMOND PRACTICE	1974 DIAMOND SHOW	1974 SOLO PRACTICE	1974 SOLO SHOW	1975 DIAMOND PRACTICE	1975 DIAMOND SHOW	1975 SOLO PRACTICE	1975 SOLO SHOW	1974-1975 DIAMOND PRACTICE	1974-1975 DIAMOND SHOW	1974-1975 SOLO PRACTICE	1974-1975 SOLO SHOW
LESS THAN -3.00	0	0	0	0	0	0	1142	2193	0	0	656	1238
-2.99 TO -2.00	97	255	597	1193	40	0	4499	5592	72	105	2836	3676
-1.99 TO -1.00	390	816	4623	5994	120	72	8415	10592	268	380	6801	8589
-.99 TO .25	1039	3367	13145	18778	3267	3993	17459	21447	2039	3734	15622	20285
2.00 TO 2.99	81364	84592	87264	112699	56972	70252	80396	100789	70411	76181	83320	105978
3.00 TO 3.99	16136	33214	38302	54744	16414	22158	41562	52675	16261	26730	40174	53577
4.00 TO 4.99	3409	10051	14528	22273	5139	6511	18881	21075	4186	7975	17028	21597
5.00 TO 5.99	779	3878	5346	10739	1474	1942	6597	9496	1091	2743	6064	10037
6.00 TO 6.99	65	1020	1447	5000	279	683	1352	3202	161	823	1392	3985
7.00 TO 7.99	0	306	252	1278	40	72	163	285	18	169	201	718
8.00 AND UP	0	0	0	57	0	0	0	44	0	0	0	50
HOURS OF DATA	30.8	19.6	31.8	35.2	25.1	27.8	42.9	45.6	55.9	47.4	74.7	80.8

TABLE XIII
OSCILLOGRAPH DATA
CROSS COUNTRY CUMULATIVE EXCEEDANCES AND RATES PER 1000 HOURS

	CUMULATIVE EXCEEDANCES			CUMULATIVE EXCEEDANCE RATES PER 1000 HOURS		
	1974	1975	1974/75	1974	1975	1974/75
LESS THAN -3.00	0	7	7	0	234	90
-2.99 TO -2.00	4	30	34	83	1003	438
-1.99 TO -1.00	32	55	87	670	1839	1121
-.99 TO .25	96	115	211	2012	3846	2719
2.00 TO 2.99	558	549	1107	11698	18361	14265
3.00 TO 3.99	191	266	457	4004	8896	5889
4.00 TO 4.99	84	107	191	1761	3578	2461
5.00 TO 5.99	41	35	76	859	1170	979
6.00 TO 6.99	17	7	24	356	234	309
7.00 TO 7.99	1	1	2	20	33	25
8.00 AND UP	0	0	0	0	0	0
HOURS OF DATA	47.7	29.9	77.6	47.7	29.9	77.6

TABLE XIV

OSCILLOGRAPH VS. COUNTING ACCELEROMETER EXCEEDANCES

YEAR	SERIAL NUMBER	AIRCRAFT POSITION	UTILIZATION	COUNTING ACCELEROMETER 5	6	7	8	OSCILLOGRAPH 5	6	7	8	OSC. HOURS
1974	154986	#4 DIAM	PRACTICE	34	6	0	0	21	1	0	0	30.8
			SHOW	73	22	6	0	71	18	4	0	19.6
				107	28	6	0	92	19	4	0	50.4
1974	155029	#5 SOLO	PRACTICE	41	9	1	0	44	9	0	0	10.1
			SHOW	122	45	5	0	130	45	4	0	14.3
				163	54	6	0	174	54	4	0	24.4
1974	154179	#6 SOLO	PRACTICE	72	6	1	0	58	4	0	0	17.6
			SHOW	106	41	4	1	98	39	4	1	9.9
				178	47	5	1	156	43	4	1	27.5
1974	154177	#6 SOLO	PRACTICE	48	29	5	0	45	28	5	0	4.1
			SHOW	147	90	26	0	135	84	26	0	11.0
				195	119	31	0	180	112	31	0	15.1
1975	154975	#4 DIAM	PRACTICE	45	8	0	0	36	7	0	0	25.1
			SHOW	54	18	4	1	51	16	2	0	27.8
				99	26	4	1	87	23	2	0	52.9

TABLE XIV

OSCILLOGRAPH VS. COUNTING ACCELEROMETER EXCEEDANCES

YEAR	SERIAL NUMBER	AIRCRAFT POSITION	UTILIZATION	COUNTING ACCELEROMETER 5/76	6/17	7/3	8/0	OSCILLOGRAPH 5/63	6/9	7/1	8/0	OSC. HOURS
1975	155029	#5 SOLO	PRACTICE	123	51	8	1	116	46	7	1	12.5
			SHOW	199	68	11	1	179	55	8	1	26.3
1975	154176	#6 SOLO	PRACTICE	5/244	6/48	7/5	8/0	5/214	6/44	7/3	8/0	29.1
			SHOW	390	123	5	0	305	94	5	0	33.1
				634	171	10	0	519	138	8	0	62.2

TABLE XV

DIAMOND AND SOLO SURVEY:
PERCENT EXCEEDANCES IN ALTITUDE AND AIRSPEED RANGES

DIAMOND 1974-1975

PERCENT OF TOTAL EXCEEDANCES	ALTITUDE RANGE IN METRES (FT.)	PERCENT EXCEEDANCES IN ALTITUDE RANGE LESS THAN 300 KNOTS	LESS THAN 400 KNOTS	LESS THAN 500 KNOTS	LESS THAN 600 KNOTS
50.6	LESS THAN 60.93(2000)	11.3	67.7	98.9	99.9
92.6	LESS THAN 1523.7(5000)	14.8	75.0	99.3	99.9
99.4	LESS THAN 3047.7(10000)	17.0	75.9	99.3	99.9
99.8	LESS THAN 4571.7(15000)	17.0	75.9	99.3	99.9
100.0	LESS THAN 9143.7(30000)	17.0	75.9	99.3	99.9

SOLO 1974-1975

PERCENT OF TOTAL EXCEEDANCES	ALTITUDE RANGE IN METRES (FT.)	PERCENT EXCEEDANCES IN ALTITUDE RANGE LESS THAN 300 KNOTS	LESS THAN 400 KNOTS	LESS THAN 500 KNOTS	LESS THAN 600 KNOTS
58.9	LESS THAN 609.3(2000)	5.6	57.9	98.7	99.9
87.2	LESS THAN 1523.7(5000)	12.5	67.5	99.0	99.9
99.1	LESS THAN 3047.7(10000)	18.7	71.1	99.1	99.9
99.7	LESS THAN 4571.7(15000)	18.9	71.3	99.1	99.9
100.0	LESS THAN 9143.7(30000)	18.9	71.3	99.1	99.9

ACKNOWLEDGEMENT

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REFERENCES

(a) McDonnell Douglas Corporation Report Number, MDC J6698/01, "A-4FBA Blue Angel Wing Fatigue Analysis," March 1975

(b) Century Model 409 Instruction, Century Electronics and Instruments, Tulsa, Oklahoma

(c) Barber, Clyde, "Naval Flight Loads Research Program," Digest of United States Naval Aviation Electronics/TPD Booklet 7-65, September 1965

(d) Naval Air Engineering Center Report No. NAEC-ASL-1106, Survey of Flight Load Parameters of Service Aircraft, Seventh Summary, 13 June 1967

APPENDIX A

INSTRUMENTATION DESCRIPTION

Instrumentation Description

The Century model 409 oscillograph system (Figure A-1), consisting of the oscillograph, bridge balance unit, pressure and acceleration transducers, and associated components, was designed for applications where space and weight requirements are critical, as well as for adverse shock, vibration, and temperature conditions. Weighing approximately 9.072 kilograms (20 pounds), this system is capable of continuously monitoring eight flight parameters, each simultaneously recorded on a photosensitive film or paper. (Figure A-2 shows the recording galvanometers used in this unit). In principle, the oscillograph records deviations of current flow in a galvanometer coil from those current values associated with level flight. Each flight parameter is associated with its own transducer and galvanometer. As the transducer changes the current flow in the galvanometer coil, motor action deflects the mirror in a direction and amount determined by the transducer output. As the mirror is deflected, the trace of the light beam is recorded on the moving film or paper via the optical system shown in Figure A-3. Using a series of collimating mirrors, the light beam is narrowed until the projection of light from each galvanometer on the film (or paper) is a very small spot. When several flight parameters (galvanometers) are being recorded, necessary trace identification is made by momentarily interrupting each light path in sequence. Since the sequence of interruption is independent of the trace position on the film (or paper), it is always possible to determine which galvonometer is responsible for a particular trace. The rate of interruption varies with film/(paper) speed, so regardless of that speed, a trace is interrupted the same number of times in a given length of record. Magazines of the light sensitive film, called records, are 45.72 metres (150 feet) long and are capable of recording approximately five hours of flight time (the oscillograph is activated only in the wheels up configuration) at a rate of 0.1524 metres (6 inches) per minute. Oscillograph units for the A-4F Blue Angel flight usage data study provided a continuous time history of aircraft airspeed, altitude, and normal acceleration. The recording portion of the oscillograph in all instrumented aircraft was located at fuselage station 20 in the nose compartment. Airspeed and altitude transducers were located approximately at fuselage station 30.0. The normal acceleration transducer, mounted on rigid structure close to the aircraft center of gravity to eliminate angular accelerations, was located at fuselage station 236.0 port side frame.

Systron-Donner counting accelerometer units (Figure A-4) weighing approximately 2.268 kilograms (5 pounds), provide an automatic, in-flight (wheels-up) permanent record of normal acceleration at four pre-set load or "g" levels. The transducer is a solid state, force-balance device whose output voltage is indicative of the induced magnetic field voltage required to return a mass to its neutral (level flight) position. Output voltage is registered by the indicator via window counters, with each window corresponding to a different load/g level. By taking periodic readings and comparing with previous readings, the cumulative number of exceedances at each level can be determined for the time interval between readings.

Counting accelerometer units installed in Blue Angel aircraft for this study measured normal accelerations at the 5.0, 6.0, 7.0, and 8.0g levels. These units are referred to as "dash seven" type. MIL SPEC A-22145BAS (February 28, 1970) requires the counting accelerometer to operate within +0.1g at the 5.0 and 6.0g levels, and within ±0.15g at the 7.0 and 8.0g levels. Transducer serial numbers and calibration levels for Blue Angel aircraft are indicated in Table A-I. The transducers were located at fuselage station 236.0 port side frame, beside the oscillograph transducer. Indicators were located in the portside landing gear wheel well.

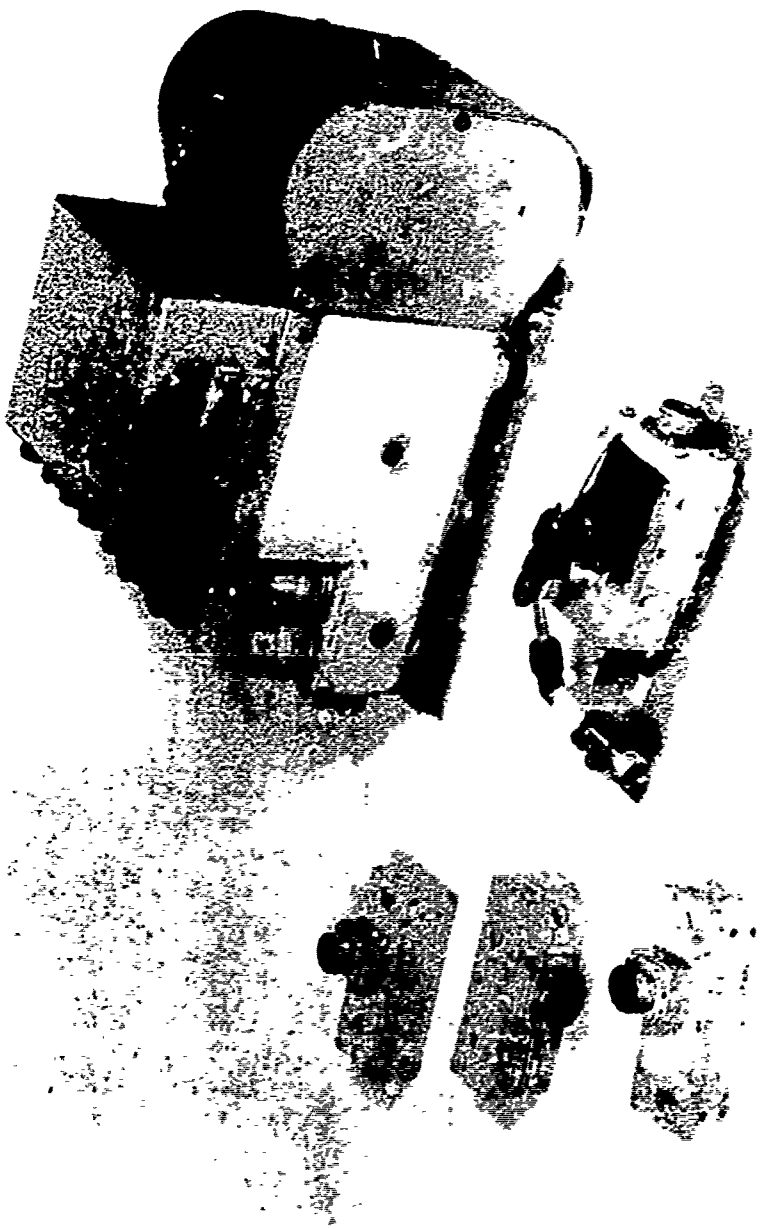

Figure A-1. Oscillograph System

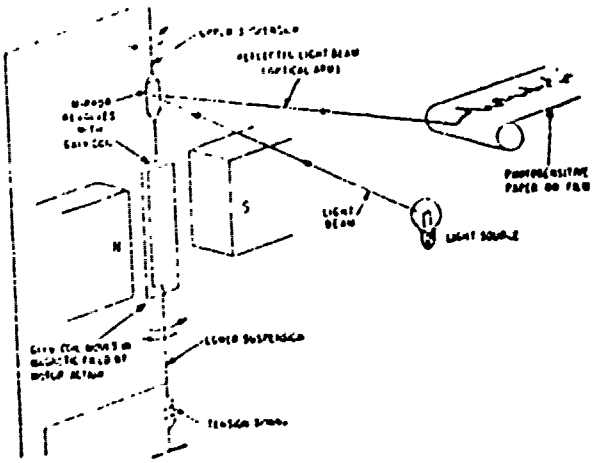

FIGURE A-2: GALVANOMETER UNIT

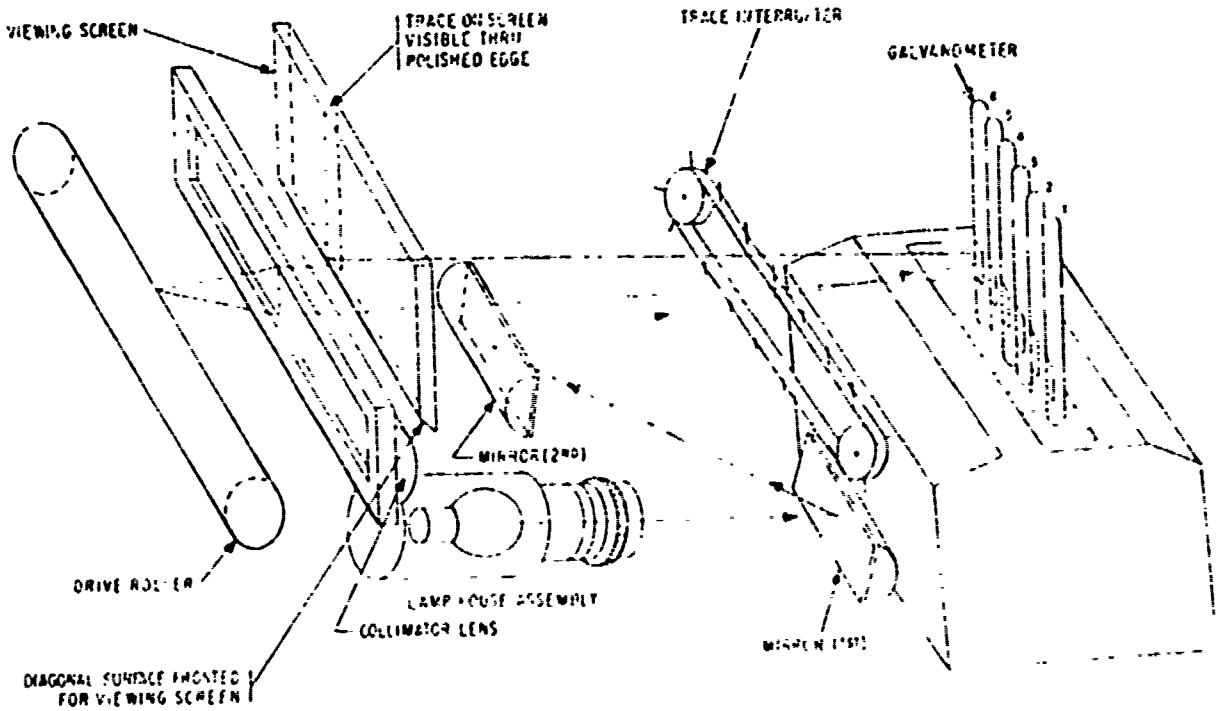

FIGURE A-3: OSCILLOGRAPH OPTICAL SYSTEM

Figure A-4. Counting Accelerometer System

TABLE A-I

TRANSDUCER SERIAL NUMBER AND CALIBRATION LEVELS

SERIAL NUMBER	TRANSDUCER	DATE INSTALLED	CALIBRATION LEVELS 5	6	7	8
154176	CXY 5171	3/6/74	5.03	6.01	7.04	8.07
	CXY 5140	4/2/75	4.99	6.01	7.08	8.02
	CXY 5181	8/26/75	5.09	6.08	7.08	8.07
154177	CXY 5187	3/6/74	5.09	6.08	7.12	8.11
154179	CXY 5170	3/6/74	5.03	6.01	7.04	8.07
	CXY 0941	3/23/74	5.09	6.08	7.15	8.15
154975	CXY 5183	3/6/74	5.06	6.05	7.08	8.07
154983	CXY 5188	3/6/74	5.06	6.04	6.99	8.00
	CXY 5157	5/16/74	5.06	6.08	7.08	8.10
154984	CXY 5186	3/6/74	5.09	6.08	7.08	8.11
154986	CXY 5178	3/6/74	5.09	6.08	7.12	8.15
	CXY 5177	1/15/75	5.03	6.01	7.02	8.01
155029	CXY 5124	3/6/74	5.03	6.05	7.04	8.07

APPENDIX B

BLUE ANGEL AIRCRAFT COUNTING ACCELEROMETER

DATA BY UTILIZATION FOR 1974 AND 1975

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154176

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	15.8	15.8	24	3	0	0
PRACTICE SOLO	14.1	14.1	37	3	0	0
SHOW DIAMOND	11.6	11.6	24	5	0	0
SHOW SOLO	0.7	0.7	15	5	0	0
CROSS COUNTRY	83.1	83.1	23	5	1	1
CHECK OUT	11.2	11.2	10	2	0	0
OTHER	0.0	0.0	-	-	-	-
UNKNOWN	66.8	19.5	9	0	0	0
TOTALS	203.3	156.0	142	23	1	1

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154176

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	1.3	1.3	6	0	0	0
PRACTICE SOLO	188.0	142.1	1394	369	28	0
SHOW DIAMOND	0.0	0.0	-	-	-	-
SHOW SOLO	52.0	46.0	541	202	13	0
CROSS COUNTRY	141.3	125.9	122	27	2	0
CHECK OUT	6.3	5.0	2	1	0	0
OTHER	5.4	5.4	0	0	0	0
UNKNOWN	0.0	0.0	-	-	-	-
TOTALS	394.3	325.7	2065	599	43	0

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154177

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	21.5	21.2	16	2	0	0
PRACTICE SOLO	24.9	24.9	191	94	27	4
SHOW DIAMOND	9.7	9.7	7	0	0	0
SHOW SOLO	33.8	33.8	426	242	70	3
CROSS COUNTRY	122.6	122.6	68	24	4	0
CHECK OUT	6.1	6.1	8	3	0	0
OTHER	0.0	0.0	-	-	-	-
UNKNOWN	121.5	9.7	7	7	2	0
TOTALS	340.1	228.0	723	372	103	7

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154177

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	106.5	97.6	92	15	4	1
PRACTICE SOLO	26.9	23.2	163	23	0	0
SHOW DIAMOND	47.5	43.1	84	30	12	3
SHOW SOLO	0.0	0.0	-	-	-	-
CROSS COUNTRY	131.0	122.7	7	1	0	0
CHECK OUT	5.1	5.1	4	0	0	0
OTHER	8.2	8.2	2	0	0	0
UNKNOWN	2.6	2.6	0	0	0	0
TOTALS	327.8	302.5	352	69	16	4

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154179

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	2.0	2.0	1	0	0	0
PRACTICE SOLO	58.3	41.4	194	25	3	0
SHOW DIAMOND	1.7	1.7	4	0	0	0
SHOW SOLO	25.6	25.6	242	97	11	2
CROSS COUNTRY	70.1	65.8	32	6	2	0
CHECK OUT	4.4	4.4	10	1	0	0
OTHER	0.0	0.0	-	-	-	-
UNKNOWN	138.2	19.3	7	2	0	0
TOTALS	300.3	160.2	490	131	16	2

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154179

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	196.0	196.0	366	84	12	0
PRACTICE SOLO	5.2	5.2	18	10	4	1
SHOW DIAMOND	51.6	51.6	102	34	8	0
SHOW SOLO	0.0	0.0	-	-	-	-
CROSS COUNTRY	149.1	149.1	13	3	1	0
CHECK OUT	3.7	3.7	8	0	0	0
OTHER	5.8	5.8	0	0	0	0
UNKNOWN	1.6	1.6	0	0	0	0
TOTALS	413.0	413.0	507	131	25	1

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154975

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	86.2	77.5	81	7	0	0
PRACTICE SOLO	0.0	0.0	-	-	-	-
SHOW DIAMOND	49.4	47.2	94	8	1	0
SHOW SOLO	0.0	0.0	-	-	-	-
CROSS COUNTRY	112.3	108.9	5	0	0	0
CHECK OUT	4.6	4.6	0	0	0	0
OTHER	1.2	1.2	0	0	0	0
UNKNOWN	26.8	4.9	0	0	0	0
TOTALS	280.5	244.3	180	15	1	0

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154975

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	192.3	192.3	329	90	12	0
PRACTICE SOLO	6.7	6.7	60	24	6	0
SHOW DIAMOND	55.2	55.2	104	33	4	1
SHOW SOLO	0.0	0.0	-	-	-	-
CROSS COUNTRY	151.3	151.3	10	1	0	0
CHECK OUT	1.9	1.9	6	3	0	0
OTHER	2.6	2.6	0	0	0	0
UNKNOWN	0.0	0.0	-	-	-	-
TOTALS	410.0	410.0	509	151	22	1

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154983

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	84.2	84.2	50	30	3	0
PRACTICE SOLO	3.4	3.4	0	0	0	0
SHOW DIAMOND	38.5	38.5	39	27	6	0
SHOW SOLO	0.0	0.0	-	-	-	-
CROSS COUNTRY	99.1	99.1	3	2	0	0
CHECK OUT	7.8	7.8	0	0	0	0
OTHER	5.0	5.0	0	0	0	0
UNKNOWN	133.3	7.6	0	0	0	0
TOTALS	371.3	245.6	92	59	9	0

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154983

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	91.9	91.9	62	10	0	0
PRACTICE SOLO	6.0	6.0	43	12	1	0
SHOW DIAMOND	43.6	43.6	40	10	0	0
SHOW SOLO	0.0	0.0	-	-	-	-
CROSS COUNTRY	125.8	125.8	1	0	0	0
CHECK OUT	5.4	5.4	1	0	0	0
OTHER	12.5	12.5	2	0	0	0
UNKNOWN	0.0	0.0	-	-	-	-
TOTALS	285.2	285.2	149	32	1	0

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154984

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	93.9	81.9	60	5	0	0
PRACTICE SOLO	0.0	0.0	-	-	-	-
SHOW DIAMOND	40.9	40.9	22	0	0	0
SHOW SOLO	0.0	0.0	-	-	-	-
CROSS COUNTRY	113.3	113.3	6	0	0	0
CHECK OUT	6.5	6.5	5	0	0	0
OTHER	0.0	0.0	-	-	-	-
UNKNOWN	110.9	3.2	0	0	0	0
TOTALS	365.5	245.8	93	5	0	0

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154984

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	144.8	144.8	88	17	3	0
PRACTICE SOLO	44.7	44.7	191	35	4	0
SHOW DIAMOND	11.7	11.7	10	1	0	0
SHOW SOLO	17.8	17.8	134	46	10	0
CROSS COUNTRY	102.4	102.4	24	5	0	0
CHECK OUT	2.2	2.2	0	0	0	0
OTHER	0.0	0.0	-	-	-	-
UNKNOWN	1.6	1.6	0	0	0	0
TOTALS	325.2	325.2	447	104	17	0

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154986

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	83.0	83.0	105	23	3	0
PRACTICE SOLO	0.0	0.0	-	-	-	-
SHOW DIAMOND	42.6	42.6	166	55	23	7
SHOW SOLO	0.0	0.0	-	-	-	-
CRISS COUNTRY	118.8	118.8	6	2	1	0
CHECK OUT	2.5	2.5	0	0	0	0
OTHER	10.1	10.1	11	1	0	0
UNKNOWN	14.6	1.7	0	0	0	0
TOTALS	271.6	258.7	288	81	27	7

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 154986

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	150.7	150.7	221	64	16	3
PRACTICE SOLO	20.6	20.6	132	43	3	0
SHOW DIAMOND	12.7	12.7	30	8	1	1
SHOW SOLO	1.5	1.5	16	6	0	0
CROSS COUNTRY	59.5	59.5	5	3	2	2
CHECK OUT	3.3	3.3	17	8	0	0
OTHER	5.0	5.0	0	0	0	0
UNKNOWN	3.7	3.7	0	0	0	0
TOTALS	257.0	257.0	421	132	22	6

1974

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 155029

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	1.2	1.2	4	1	0	0
PRACTICE SOLO	83.6	83.6	456	75	8	0
SHOW DIAMOND	0.0	0.0	-	-	-	-
SHOW SOLO	41.7	41.7	383	136	10	0
CROSS COUNTRY	106.2	106.2	75	18	0	0
CHECK OUT	6.3	6.3	6	3	0	0
OTHER	3.1	3.1	0	0	0	0
UNKNOWN	44.1	1.4	8	4	1	0
TOTALS	286.2	243.5	932	237	19	0

1975

UTILIZATION - BLUE ANGEL COUNTING ACCELEROMETER DATA

SERIAL NUMBER: 155029

UTILIZATION	HOURS FLOWN	ACCEPTABLE COUNTING ACCELEROMETER	EXCEEDANCES 5	6	7	8
PRACTICE DIAMOND	0.0	0.0	-	-	-	-
PRACTICE SOLO	136.0	136.0	1023	218	19	1
SHOW DIAMOND	0.0	0.0	-	-	-	-
SHOW SOLO	36.5	36.5	387	180	36	6
CROSS COUNTRY	102.6	102.6	75	22	2	0
CHECK OUT	5.1	5.1	7	6	1	0
OTHER	3.9	3.9	0	0	0	0
UNKNOWN	1.2	1.2	0	0	0	0
TOTALS	285.3	285.3	1492	426	58	7

APPENDIX C

SURVEY OF AIRSPEED, ALTITUDE, AND EXCEEDANCE FOR 1974-1975 DIAMOND AND SOLO

A4F BLUE ANGELS 1974-1975 DIAMOND

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE -2000 TO -1 FEET
(-609.60 TO -.30 METRES)

AVERAGE GROSS WEIGHT 15110 POUNDS
(6853.66 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	0	0	0	0	0	0	0	0
-1.99 TO -1.00	0	0	0	0	0	0	0	0	0	0	0	0
-.99 TO .25	0	0	0	0	3	2	0	0	0	0	0	5
2.00 TO 2.99	0	0	0	1	21	68	71	21	4	0	0	186
3.00 TO 3.99	0	0	0	0	0	7	10	5	0	0	0	22
4.00 TO 4.99	0	0	0	0	0	2	0	0	0	0	0	2
5.00 TO 5.99	0	0	0	0	0	0	0	0	1	0	0	1
6.00 TO 6.99	0	0	0	0	0	0	0	0	0	0	0	0
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	0	0	0	1	24	79	81	26	5	0	0	216

A4F BLUE ANGELS 1974-1975 DIAMOND

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 0 TO 1999 FEET
(.00 TO 609.30 METRES)

AVERAGE GROSS WEIGHT 14669 POUNDS
(6651.67 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	1	0	0	0	0	0	0	0	1
-1.99 TO -1.00	0	0	0	0	1	1	0	0	0	0	0	2
-.99 TO .25	0	0	3	11	24	36	5	7	3	0	0	89
2.00 TO 2.99	0	2	92	394	1064	1149	732	217	18	3	3	3674
3.00 TO 3.99	0	0	11	55	102	401	334	112	7	3	0	1025
4.00 TO 4.99	0	0	0	28	31	58	72	41	4	0	0	234
5.00 TO 5.99	0	0	0	2	7	11	15	6	5	2	0	48
6.00 TO 6.99	0	0	0	0	1	6	5	4	1	0	0	17
7.00 TO 7.99	0	0	0	0	1	0	2	2	1	0	0	6
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	0	2	106	491	1231	1662	1165	389	39	8	3	5096

A4F BLUE ANGELS 1974-1975 DIAMOND

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 2000 TO 4999 FEET
(609.60 TO 1523.70 METRES)

AVERAGE GROSS WEIGHT 14634 POUNDS
(6637.94 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	1	0	0	0	0	0	0	1
-1.99 TO -1.00	0	0	0	0	6	0	0	0	0	0	0	6
-.99 TO .25	0	5	5	36	35	31	6	0	0	0	0	118
2.00 TO 2.99	0	6	117	604	1243	758	219	46	4	0	0	2997
3.00 TO 3.99	0	0	7	46	180	373	221	51	5	0	0	883
4.00 TO 4.99	0	0	1	15	58	91	69	34	1	1	0	270
5.00 TO 5.99	0	0	1	3	28	36	35	9	0	0	0	112
6.00 TO 6.99	0	0	0	0	1	10	7	2	0	0	0	20
7.00 TO 7.99	0	0	0	0	0	0	1	1	1	0	0	3
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	0	11	131	704	1552	1299	558	143	11	1	0	4410

A4F BLUE ANGELS 1974-1975 DIAMOND

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 5000 TO 9999 FEET
(1524.00 TO 3047.70 METRES)

AVERAGE GROSS WEIGHT 14456 POUNDS
(6556.97 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	3	4	0	0	0	0	0	7
-1.99 TO -1.00	0	0	2	4	11	2	0	0	0	0	0	19
-.99 TO .25	8	11	16	55	28	16	3	3	0	0	0	140
2.00 TO 2.99	0	5	54	150	99	40	11	0	0	1	0	360
3.00 TO 3.99	0	0	2	18	27	43	19	19	1	0	0	129
4.00 TO 4.99	0	0	0	4	15	8	5	8	2	0	0	42
5.00 TO 5.99	0	0	0	0	1	5	5	2	1	0	0	14
6.00 TO 6.99	0	0	0	0	0	1	5	2	0	0	0	8
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	8	16	74	231	184	119	48	34	4	1	0	719

A4F BLUE ANGELS 1974-1975 DIAMOND

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 10000 TO 14999 FEET
(3048.00 TO 4571.70 METRES)

AVERAGE GROSS WEIGHT 15298 POUNDS
(6938.96 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	0	0	0	0	0	0	0	0
-1.99 TO -1.00	0	0	0	0	0	0	0	0	0	0	0	0
-.99 TO .25	0	0	0	0	1	13	1	1	0	0	0	16
2.00 TO 2.99	0	0	1	4	7	5	1	2	0	0	0	20
3.00 TO 3.99	0	0	0	2	3	0	0	1	0	0	0	6
4.00 TO 4.99	0	0	0	1	1	1	0	0	0	0	0	3
5.00 TO 5.99	0	0	0	0	0	0	0	0	0	0	0	0
6.00 TO 6.99	0	0	0	0	0	0	0	0	0	0	0	0
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	0	0	1	7	12	19	2	4	0	0	0	45

A4F BLUE ANGELS 1974-1975 DIAMOND

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 15000 TO 29999 FEET
(4572.00 TO 9143.70 METRES)

AVERAGE GROSS WEIGHT 15667 POUNDS
(7106.28 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	0	0	0	0	0	0	0	0
-1.99 TO -1.00	0	0	0	0	0	0	0	0	0	0	0	0
-.99 TO .25	0	0	0	0	0	3	0	0	0	0	0	3
2.00 TO 2.99	0	1	0	0	3	2	1	0	0	0	0	7
3.00 TO 3.99	0	0	0	2	0	0	0	0	0	0	0	2
4.00 TO 4.99	0	0	0	0	0	0	0	0	0	0	0	0
5.00 TO 5.99	0	0	0	0	0	0	0	0	0	0	0	0
6.00 TO 6.99	0	0	0	0	0	0	0	0	0	0	0	0
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	0	1	0	2	3	5	1	0	0	0	0	12

A4F BLUE ANGELS 1974-1975 SOLO

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE -2000 TO -1 FEET
(-609.60 TO -.30 METRES)

AVERAGE GROSS WEIGHT 15121 POUNDS
(6858.71 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	0	0	1	0	0	0	0	1
-1.99 TO -1.00	0	0	0	0	0	3	2	0	0	0	0	5
-.99 TO .25	0	0	0	1	1	4	7	0	0	0	0	13
2.00 TO 2.99	0	0	1	8	7	13	9	1	0	0	0	39
3.00 TO 3.99	0	0	0	2	7	11	11	2	0	0	0	33
4.00 TO 4.99	0	0	0	0	4	4	10	1	0	0	0	19
5.00 TO 5.99	0	0	0	0	0	4	5	0	0	0	0	9
6.00 TO 6.99	0	0	0	0	0	1	5	1	1	0	0	8
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	0	0	1	11	19	40	50	5	1	0	0	127

A4F BLUE ANGELS 1974-1975 SOLO

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 0 TO 1999 FEET
(.00 TO 609.30 METRES)

AVERAGE GROSS WEIGHT 14776 POUNDS
(6702.34 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	10	106	54	1	0	0	0	171
-2.99 TO -2.00	0	0	1	0	9	280	312	7	2	0	0	611
-1.99 TO -1.00	1	0	16	14	23	342	405	5	0	0	0	806
-.99 TO .25	0	0	27	21	84	419	420	40	11	3	0	1025
2.00 TO 2.99	0	2	83	553	1284	1877	1358	243	57	7	0	5464
3.00 TO 3.99	1	0	10	159	532	1510	1283	323	54	5	0	3877
4.00 TO 4.99	0	0	0	11	166	868	927	171	37	8	1	2189
5.00 TO 5.99	0	0	0	1	39	625	503	75	10	0	0	1253
6.00 TO 6.99	0	0	0	1	5	214	284	46	10	2	0	562
7.00 TO 7.99	0	0	0	0	1	12	55	13	1	0	0	82
8.00 AND UP	0	0	0	0	0	0	1	2	1	0	0	4
TOTAL EXCEEDANCES	2	2	137	760	2153	6253	5602	926	183	25	1	16044

A4F BLUE ANGELS 1974-1975 SOLO

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 2000 TO 4999 FEET
(609.60 TO 1523.70 METRES)

AVERAGE GROSS WEIGHT 15126 POUNDS
(6861.23 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	1	4	12	7	0	0	0	0	24
-2.99 TO -2.00	0	0	1	4	3	18	8	0	0	0	0	34
-1.99 TO -1.00	0	8	21	20	23	35	16	1	0	0	0	124
-.99 TO .25	2	6	55	132	292	218	59	9	0	0	0	773
2.00 TO 2.99	0	12	301	1175	1392	781	279	49	4	1	0	3994
3.00 TO 3.99	0	1	19	305	781	630	243	55	8	0	0	2042
4.00 TO 4.99	0	0	0	13	177	246	112	18	4	0	1	571
5.00 TO 5.99	0	0	0	1	11	70	44	8	2	0	0	136
6.00 TO 6.99	0	0	0	0	0	13	8	2	0	0	0	23
7.00 TO 7.99	0	0	0	0	0	1	4	1	0	0	0	6
8.00 AND UP	0	0	0	0	0	0	1	0	0	0	0	1
TOTAL EXCEEDANCES	2	27	397	1651	2683	2024	821	143	18	1	1	7768

A4F BLUE ANGELS 1974-1975 SOLO

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 5000 TO 9999 FEET
(1524.00 TO 3047.70 METRES)

AVERAGE GROSS WEIGHT 15286 POUNDS
(6933.60 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	2	4	0	0	0	0	0	0	0	8
-1.99 TO -1.00	1	8	62	40	5	8	1	0	0	0	0	125
-.99 TO .25	16	71	174	244	135	39	6	1	0	0	0	686
2.00 TO 2.99	1	16	383	832	417	118	24	2	0	0	0	1793
3.00 TO 3.99	0	1	22	223	204	74	36	3	0	0	0	563
4.00 TO 4.99	0	0	0	14	37	25	7	1	0	0	0	84
5.00 TO 5.99	0	0	0	0	0	7	1	0	0	0	0	8
6.00 TO 6.99	0	0	0	0	0	2	0	0	0	0	0	2
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	18	96	643	1359	798	273	75	7	0	0	0	3269

A4F BLUE ANGELS 1974-1975 SOLO

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 10000 TO 14999 FEET
(3048.00 TO 4571.70 METRES)

AVERAGE GROSS WEIGHT 15429 POUNDS
(6998.68 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	0	1	0	0	0	0	0	1
-1.99 TO -1.00	0	0	0	1	0	3	0	0	0	0	0	4
-.99 TO .25	2	1	11	16	12	19	1	0	0	0	0	62
2.00 TO 2.99	0	1	11	26	17	11	1	0	0	0	0	67
3.00 TO 3.99	0	0	0	14	11	10	1	0	0	0	0	36
4.00 TO 4.99	0	0	0	0	1	7	0	0	0	0	0	8
5.00 TO 5.99	0	0	0	0	1	1	0	0	0	0	0	2
6.00 TO 6.99	0	0	0	0	0	0	0	0	0	0	0	0
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	2	2	22	57	42	52	3	0	0	0	0	180

A4F BLUE ANGELS 1974-1975 SOLO

OBSERVED NORMAL LOAD FACTOR VS. EQUIVALENT AIRSPEED TABULATION

ALTITUDE 15000 TO 29999 FEET
(4572.00 TO 9143.70 METRES)

AVERAGE GROSS WEIGHT 15127 POUNDS
(6861.62 KILOGRAMS)

EQUIVALENT AIRSPEED, KNOTS

LOAD FACTOR	100 TO 149	150 TO 199	200 TO 249	250 TO 299	300 TO 349	350 TO 399	400 TO 449	450 TO 499	500 TO 549	550 TO 599	600 TO 649	TOTAL
LESS THAN -3.00	0	0	0	0	0	0	0	0	0	0	0	0
-2.99 TO -2.00	0	0	0	0	1	4	0	0	0	0	0	5
-1.99 TO -1.00	0	0	1	1	5	2	0	0	0	0	0	9
-.99 TO .25	1	0	0	6	8	12	0	0	0	0	0	27
2.00 TO 2.99	0	0	0	1	9	9	1	0	0	0	0	20
3.00 TO 3.99	0	0	0	2	2	1	0	0	0	0	0	5
4.00 TO 4.99	0	0	0	0	0	0	0	0	0	0	0	0
5.00 TO 5.99	0	0	0	0	0	0	0	0	0	0	0	0
6.00 TO 6.99	0	0	0	0	0	0	0	0	0	0	0	0
7.00 TO 7.99	0	0	0	0	0	0	0	0	0	0	0	0
8.00 AND UP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXCEEDANCES	1	0	1	10	25	28	1	0	0	0	0	66